Heating Piping & Air Conditioning

with which is merged the Aerologist

Design, Installation, Operation, and Maintenance: Industrial, Commercial, Institutional, and Public Buildings

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THE EDITOR'S PAGES

BUILDING INDUSTRY MIDWAY IN ADJUSTMENT

An analysis of trends in the construction industry since V-J Day indicates that building now is somewhere near midpoint of the postwar adjustment phase, according to Thomas S. Holden, president of F. W. Dodge Corp.

With the filling of building materials supply pipe lines and passage of the price peaks in different lines of agriculture, raw material extraction, and industry generally, Mr. Holden observes, it is convenient to consider September 1948, when the all-commodity index of wholesale prices turned down, as the date when the adjustment phase of postwar recovery succeeded the backlog and shortage phase.

Characteristics of the present market adjustment phase, Mr. Holden states, have been the disappearance of acute shortages, gray markets, and order backlogs, with the return of competition, downward price movements, and temporary cutbacks or postponements of expansion programs of industry.

This general adjustment movement, Mr. Holden points out, has been reflected in a reduction of the physical volume of production, slight decline in department store sales, a significant drop in wholesale commodity index, decline in employment, and decline in both the dollar volume and physical volume of construction contracted for.

Mr. Holden declares that the adjustment is incomplete because the public expects further price cuts, jobbers and dealers are buying on a hand to mouth basis in anticipation of further price cuts, business and industry have doubts about action on taxation, proposed welfare legislation, and government spending.

"Odds favor continuance of adjustment in a mild orderly manner until an adequate basis for business upturn is reached," Mr. Holden says. "Adjustment has made much progress already without developing any panic psychology.

"Market adjustment is a preparation for resumption of postwar recovery on an everwidening front. The natural peacetime course of a dynamic society like ours, where adjustments have been corrected, is economic expansion.

"Potential expansion factors in the American economy are very great, perhaps greater than ever before," according to the Dodge executive. "They include our growing population, our position of world leadership, our high productivity, our tremendous volume of liquid savings, our habits of ready adaptation to change, our high competence in business and industrial management and construction techniques, and the energy and resourcefulness of our people."

With respect to construction demands of the 1950's, based on the assumption that there will be a predominantly favorable economic and political climate, Mr. Holden foresees increases in commercial, industrial, school, hospital, public, religious, social, and recreational building.

Heavy engineering construction, public and private, is likely to increase continuously to keep pace with needs for expanded community facilities, power, traffic, transportation needs, and the like. Large backlogs of planned projects exist now, he states.

"Residential building," Mr. Holden observes, "should continue relatively high, probably less than the 1948 volume, during the next several years. Acute shortages have been met, the rate of new family formations has fallen considerably from the 1947 peak and is likely to continue during the 50's at a lower rate than in the war and postwar years. The low birth rate of the 30's results in fewer people of marriageable age in the 50's.

"Rental housing currently lags behind, particularly in larger cities, indicating need for increased building of apartment houses, perhaps a combination of public housing, cooperative housing, and investment housing. With prosperity, new building to replace substandard housing is likely to increase, but not at rates indicated in propaganda estimates of recent years. Single family houses built to order for owners' occupancy are likely to increase in proportion to national prosperity."

"QUOTE"

"That portion of city air pollution caused by smoke is unneighborly as well as unnecessary. Such a community problem is one that can be improved by city-wide cooperation. First, an engineering survey can determine what-to-do and how-to-do-it. Then everybody must work together—you, me, the neighbor next door, the mayor, the janitor down the street, and the fireman tending the steam boiler plant across the tracks.

"Secondly, people must learn that smoke means waste and inefficiency. They must be educated in the ways and means for getting maximum heating efficiency, without smoke. Burning equipment properly adjusted and operated saves money and helps keep a clean city."—*from a booklet just issued by the Bituminous Coal Institute, entitled What's in the Air?*

A. C. BOOSTS SALES FOR FOOD MARKETS

Results of a single test installation last year have led to a decision to air condition an entire chain of super markets, in one of the first large scale air conditioning projects for food stores in the New York metropolitan area. Typhoon Air Conditioning Co., Inc., Brooklyn, N. Y. reports that Shopwell Foods, Inc., which placed units in its Scarsdale outlet in 1948, has ordered them for a total of 10 stores, with additional installations in the planning stage.

A careful analysis of sales figures in the warm weather months following the first trial disclosed a sharp climb in summer volume to a point which exceeded the best winter months. These gains were registered in the face of keen competition. Shopwell executives are now firmly convinced that business increases more than pay for the cost of air conditioning.

Writing in a recent issue of the magazine Super Market Merchan-

THE EDITOR'S PAGES

dising, Elias J. Zindler, AIA, who has served as architect for Shopwell Foods for 10 years, said:

"Providing for the added comfort of shoppers in a super market can do as much to accelerate sales as transforming whole departments, taking on new lines, or running bang-up promotions. Air conditioning did just that for Shopwell, and the figures show that sales were sensationally higher than in stores that had no air conditioning in the same Shopwell system of 14 units."

In his article, Mr. Zindler quoted Louis H. Taxin, Shopwell's president, as saying that "we gained many new customers during the hot days when these customers enjoyed the comfort of our market. Once we were able to attract them with air conditioning, we made regular customers out of them and that carried through the rest of the year. In my opinion [said Mr. Taxin] that is the most important advantage of air conditioning a food market."

POSTPONES RULING ON WELDER RADIO INTERFERENCE

The Federal Communications Commision has had under consideration since April 1948 rules respecting radio interference which would affect the development and use of electric arc welding devices utilizing radio frequency energy as part of the welding process. At a meeting of the commission last July the effective date of a proposed order applying such rules was postponed until January 31, 1950. While this action allows the continued manufacture and sale of high frequency stabilized arc welding equipment, the postponement was granted by the commission to provide more time for further investigation of high frequency stabilized arc welders and for further study of high frequency radiation from this apparatus.

In this welding process, high frequency current is used to stabilize inert gas shielded arc welding, particularly in the welding of aluminum and magnesium.

The problem of radio interference attributed to this equipment has been studied intensely by a Joint Industry Committee on High Frequency Stabilized Arc Welders, which is composed of manufacturers of high frequency stabilized arc welding equipment, metal suppliers, and users of the apparatus. In view of the progress which has already been accomplished in the reduction of high frequency radiation from these arc welders, the committee hopes that a solution may be reached eventually which will permit the continued use of this welding method without interference to communications.

HOUSING SUPPLY UP ONE-FOURTH SINCE '40

The supply of housing in U. S. cities and towns has increased almost one-fourth since 1940, Charles M. Mortensen, executive secretary of the Producers' Council, national organization of building products manufacturers, said last month.

"The usable housing supply today exceeds 36.8 million units and is about 7.1 million units greater than it was in 1940. More than 70 percent of the additional housing consists of new construction. The remainder has come from the remodeling of existing structures to create additional dwelling units," he stated.

BUILDING, CONSTRUCTION NEAR RECORD TOTAL

F. W. Dodge Corp. has reported that the dollar volume of contracts awarded for building and engineering works in the 37 states east of the Rocky Mountains amounted to $4,467,676,000 in the first half of this year to show a decline of 6 percent from the corresponding period of last year. The total was the highest first-half volume on record, excepting only last year, the corporation's statistics show.

The increasing volume of public-account work was the principal characteristic of the half-year trend, and it affected appreciably all major classifications of building and construction, the analysis shows. Record, or near record volume for a first half period was shown in the following classifications of building: educational and science, hospitals and institutions, public buildings such as court houses, religious buildings, and social and recreational building.

HOUSTON A TOP AIR CONDITIONED CITY

Approximately $75 million has been spent in making Houston one of the top cities in air conditioning in the nation, according to the magazine Houston. The city now has approximately 107,000 tons of air conditioning, requiring approximately 120,000 hp.

And these figures do not include attic and window ventilation. When this class of cooling system is included, the total spent on cooling facilities in the city would approximate $100 million and raise the daily horsepower to probably 140,000.

A survey made by the magazine in June revealed that in excess of 77,000 tons of air conditioning equipment had been installed there since 1946.

PIPING SERVICES FOR MANUFACTURING PLANT

In the article by Louis F. Conti in the August HPAC, describing the piping services at the new Allentown plant of Western Electric Co., it was stated on page 79 that raw water was deionized or demineralized at an available rate of 16 gph. This should have read 16 gpm.

The abbreviation "FSA," used in the article in referring to drawings, meant "Factory Standards Allentown."

MAID SERVICE

When President and Mrs. Stoddard of the University of Illinois were in New York for the inauguration of Dwight Eisenhower as president of Columbia, they left their hotel awhile the first evening there. They returned to find that the maid had been in, unpacked their bags, and turned down the beds. On one bed, carefully laid out, were the president's pajamas. On the other, arranged with equal care, were his cap and gown, reports the Illinois Alumni News in a recent issue.

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"OPEN for DISCUSSION"

DO YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? We follow here the custom of engineering society meetings in allowing a period for discussion following presentation of a paper. You are invited to contribute your views. Address them to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2

DESIGN FOR GOOD OPERATION, MAINTENANCE

Reducing maintenance and operations costs has and will always present a profitable topic of discussion. In modern structures (whether it be an individual building or an industrial plant) we have many diversified operating and maintenance problems. Operating and maintenance staffs are constantly on the alert for any information or data which will simplify and thereby reduce maintenance and operating costs. Much has and will continue to be published on the subject.

I am not going to discuss this phase of maintenance, but will discuss what I believe plays a very important part toward maintenance and operating costs, from a standpoint that has not received much publicity. I recently sat in on discussions by our top management: president, vice president in charge of manufacturing, chief design engineer, and chief sales engineer. These discussions outlined to all supervision the many problems confronted in meeting competition. We have established ourselves as a maker of the highest quality products in our field. Consequently, it costs more to build our product. Competition among the manufacturers in our field is very keen. Therefore, our existence as a company is dependent upon every one of us giving full value. This means we can lose our reputation, our business, and our jobs, through inefficient, wasteful operations. Reducing maintenance and operations costs occupies an important portion in this overall cost problem.

I think we will all agree that there are many items to be considered from an economical and operating standpoint which could be given more thought and consideration during the initial preparation of plans and specifications. I believe that the consulting and designing engineers, the sales engineers representing the equipment manufacturers, and the contractors could contribute a great deal toward reduced maintenance and operating costs. Initial cost obviously plays a major role during the planning and specification stage. These costs will in some instances increase, but the resultant savings on maintenance and operating costs will amortize the aforesaid initial additional costs in a very short period of time if properly planned. Since our existing system generally is to award the contract to the lowest bidder, all ideas must be incorporated in the plans and specifications. Obviously, if the job is cost plus, or permits extras, then we can partially depend upon our field engineer to see that we are assured an installation that will mean efficient operation.

Further explanation is deemed necessary to clarify these statements, which otherwise may be misconstrued. I am not condemning or criticizing any of the parties, nor suggesting a nefarious or questionable method of operation. The existing system is the old and accepted method of operation. However, I do feel that I am in a position (with over two decades of operating experience plus some design and field engineering to back my statements) to offer suggestions which will lead to improved standards. Therefore, I shall discuss with free expression, for I shall expect criticism and my readers, as well as myself, will reap the benefits of open discussion.

I believe that the plans and specifications should make mandatory a thoroughly completed job which would accomplish all the results desired and at the same time would incorporate all the necessary facilities for economical and practical maintenance and continued operation. I believe with this assurance the client would be prepared to pay the small additional differential as compared with an average job with average costs. The equipment manufacturers could and would do considerable to help the cause, through their advertising and literature. They should stress that the customer should be aware of the fact that the finished product should be designed and installed to meet not only his present needs, but also that due consideration should be given to future operation, maintenance, and possible expansion.

There is also another problem which we should all be aware of; that is, the gap which frequently exists between the consulting designing engineer and the operating or maintenance supervision. The contractor is in the middle here. However, maintenance supervision generally assumes the job is their problem after the contractor has completed his work and as a result no effort is made to inform the contractor or designing engineer of their problems; so they commence what they feel is the necessary rework since they have to live with the job. By some method, a closer alliance should exist to the mutual advantage of all concerned.

The equipment manufacturer also has a very definite obligation in our operation. One sales engineer recently stated, "Successful installations—jobs well done—are the best non-payroll salesmen. Many a manufacturer has lost sight of the apparatus he has sold. One of the first jobs is to see that the installations already made are working right and continue to do so." This gentleman, who is now the assistant manager of the sales department of one of our largest U. S. manufacturers, made a very significant statement. I have thought the same thing many times and I could illustrate several instances where business was lost due to lack of "follow up." Let me accentuate that, while it is certainly not a duty of the sales engineer to travel around giving free consultation service, it is his duty to his customers to familiarize them with the latest developments of his products, offer suggestions to reduce operating costs, and see that his product is not the victim of misapplication.

In conclusion, let me state that we on the operating end of the job may not always be familiar with

"OPEN for DISCUSSION"

the problems involved or the decisions reached during the initial planning and construction; nevertheless, we have to live with the job and in the common interest of our continued operation, we want to be able to operate the easy and the economical way.—WILLIAM B. PRIDE, heating and ventilating engineer, Boeing Airplane Co., Seattle.

BASIC PRINCIPLES OF PIPING

I commented in the June issue on some of the points discussed by Herman Vetter in his article on basic principles of piping, which was published in March. Mr. Vetter replied—also in the June issue—to my comments, and I should like to make the additional remarks following.

I agree that the globe valve positioned as shown in the last figure of Mr. Vetter's article [and reproduced herewith as Fig. A] will not hold back condensate if it is open. I still consider, however, that the piping arrangement as shown is not the best practice—as if the valve is shut and the header is common to several boilers, condensate will flow from the header down into the valve and tend to fill up the boiler branch pipe to the bottom of the header.

Fig. A—This arrangement permits self drainage of condensate from the header, according to Mr. Vetter in his article in the March HPAC

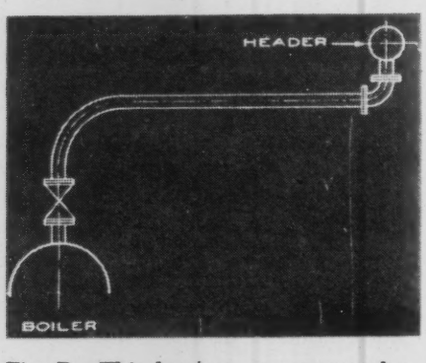
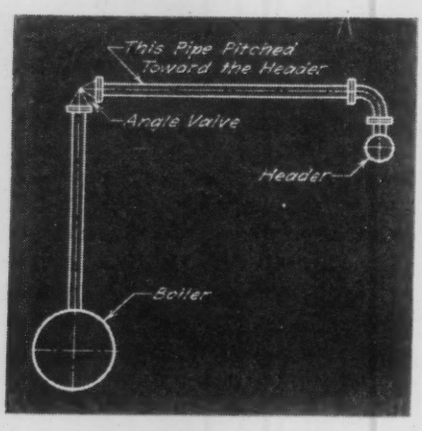


Fig. B—This header arrangement has a number of advantages, said Mr. Isherwood in his comments published in the June issue



I also consider that my arrangement [Fig. B] is superior from an expansion point of view, and would be interested to hear what Mr. Vetter has to say on this.

I note that it is recommended that when more than one boiler is connected to a header that it is good practice to have two valves in series. This arrangement I heartily endorse, as I have had very bitter experience trying to isolate boilers on one valve and I consider that an angle valve is ideal to come between the valve on the boiler and the header.

As far as condensate contra-flow is concerned I think that Mr. Vetter's statement that "The parsimonious engineer is one who sizes his lines so small that it requires a return line for draining the condensate back to the boiler" is a little wide of the mark. In these days of comparatively high fuel costs, it is usually found well worthwhile to return as much condensate as possible from process to the boiler plant and especially so if the water conditions are poor.

In most cases, the condensate return can run back to the boiler house by following the same route as the steam distribution piping and arrangements can very easily be made to transfer the condensate from the main steam piping across to the condensate return main.

I would also mention that it is always desirable to supply saturated steam as dry as possible to either process work or the prime mover. To achieve this it is desirable to keep the amount of condensate lying in the steam distribution piping to as small a quantity as possible and this state cannot be achieved by having long lengths of steam piping pitched back to the boiler without any condensate collecting and discharging arrangements.—A. D. G. ISHERWOOD, J. R. W. Murland, consulting engineer, Belfast, Ireland.

ELECTRIC STORAGE HEATING CONTROL

John Howatt's remarks published on these pages in the July issue are pertinent and bring out some points not fully covered in my article in June describing the electric storage heating installation for a school.

The method of preventing overheating of floor panels in this installation is to provide a constant flow of water to all rooms controlled as to temperature by an outdoor thermostat. A proportioning valve admits only that heat from the tanks required to maintain water temperature. To prevent local overheating from sun effect or wind, each room is provided with a limit thermostat controlling a motorized valve in the panel supply line for that room.

Inasmuch as no makeup water is required or added, there is no opportunity for appreciable deposits of minerals on the heaters or in the tanks.

It is difficult to estimate the depreciation of the electric heaters but they are of a standard commercial type which have been in use for a number of years. The smaller sizes are used in residential storage domestic water heaters.—W. BRUCE MORRISON, consulting engineer, Portland, Ore.

CONSTRUCTION EMPLOYMENT HOLDING UP WELL

Employment in the construction industry is holding up remarkably well, accompanied by a gradual increase in the productivity of building labor, James M. Ashley, president of the Producers' Council, national organization of building products manufacturers, stated recently.

Analysis of figures compiled by the Bureau of Labor Statistics shows that 2,010,000 workers were employed in contract construction during May of this year, a gain of 4 percent over April and a decline of only 2 percent from the figure for May 1948," Mr. Ashley said.

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How Air Conditioning Affects Design of Today's Skyscraper

THERE HAVE been developments in late years which give us cause to wonder whether our established conceptions of office building design are not becoming rapidly outmoded, if not actually obsolete. The factor primarily responsible for this situation is the perfection of the air conditioning system.

Air conditioning, at its inception, was a luxury adapted to the physical characteristics of existing structures. As it was further improved, however, and became more in demand, the physical characteristics of new buildings were designed to accommodate the air conditioning. Today, not only the physical specifications of buildings but their very economics of design are influenced by this development.

I believe it is safe to say that practically all large new office buildings now under construction, or in contemplation, throughout the country are to be air conditioned. This is a tremendously significant fact. Not only are the new office buildings of the south being so equipped but the buildings of the northern cities also.

It is not my purpose or intent to discuss air conditioning as such, but a reference to its increasing incidence is pertinent to the subject under discussion. This subject really is: "Owing to air conditioning, is the economic theory of office building design changing?" This is not a scarehead statement—the design of these new buildings going

GEORGE R. BAILEY, manager, Albert H. Wetten & Co. (real estate), Chicago, pointed out in an address at the 42nd annual convention of the National Association of Building Owners and Managers—held recently in Montreal—that the "perfection" of air conditioning influences not only the physical specifications of office buildings but their very economics of design as well. . . . In his address (published almost in full here) he analyzed a "standard typical floor layout" with a light court and no air conditioning and a "full typical floor layout" with air conditioning, found that the latter requires only about 10 percent more rent despite the many direct and indirect advantages of air conditioning

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up today has been radically influenced by this development.

Immediately, we are faced with a number of questions of vital significance:

1) Will all new office buildings henceforth erected be air conditioned?

2) Would it be practicable to erect a new office building without air conditioning?

3) What will be the competitive result of new air conditioned buildings?

4) Will existing buildings be forced to air condition?

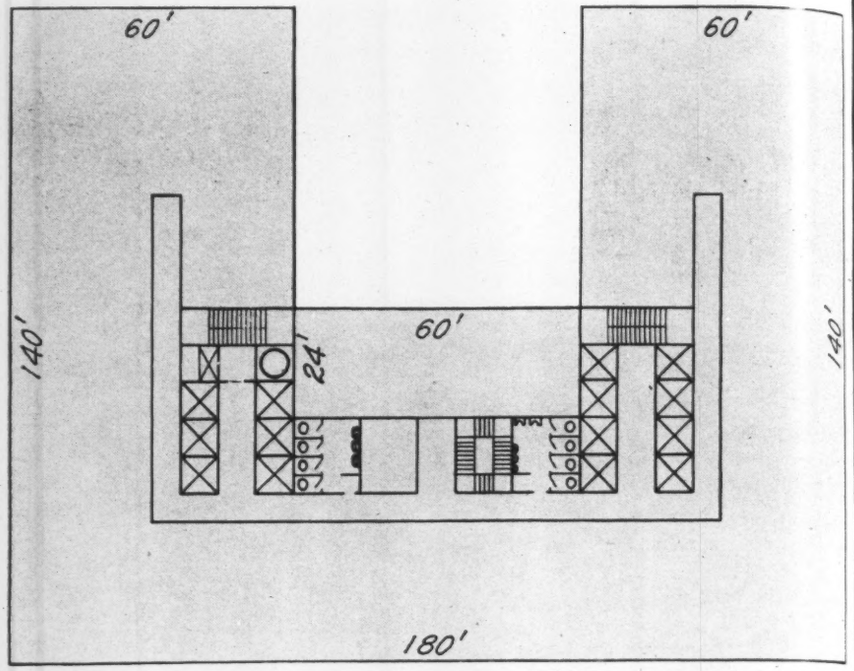
5) Will air conditioning permit an economic design that will give a new office building advantages other than just the air conditioning itself?

I would like to report on the first four of these questions but any report not based on a survey more complete than it has been possible for me to make might be misleading. The subject matter of this paper is, therefore, restricted to question No. 5, although passing comment on the first four questions is not out of place.

Erect New Building Without Conditioning?

With respect to Nos. 1 and 2, I doubt that anyone would dare to erect a large new office building today without air conditioning. This is principally true because the investment is so great, as compared with the investment required for buildings built prior to the last war, that the necessary rental rate is substantially greater—in the Chicago area in excess of $4 per sq ft.

He would be a brave—and probably a foolhardy—owner who would build an un-air conditioned building in which he would be forced to obtain more than a $4 rate for a period of 20 or 25 years with nothing to protect him against vacancy competition in more cheaply constructed buildings except the factor of newness and a few unimportant improvements or novel features of interior design. With air conditioning, he would at least have something to warrant the increase over the rate schedule of existing buildings that he must receive to remain solvent. It is for this reason that it appears unlikely and impracticable that large, new office buildings will henceforth be erected without air conditioning; and in the south and southwest, it is, of course, unlikely that a new building would be considered without this feature, regardless of the rate factor.



Standard typical floor layout as analyzed for comparison with the full typical floor layout

With respect to question No. 3, the competitive impact of new air conditioned buildings upon a given area or city will depend upon vacancy and the amount of such new, air conditioned space. One new, air conditioned building in a fairly large city would not be too serious. It would charge higher rates than existing buildings and probably only a few tenants from each would move to the new structure, which would fill up and no longer be competition. But if several such new structures were in the market and a substantial vacancy developed, so that they were in competition with one another, then the older, un-air conditioned buildings would undoubtedly face a difficult situation. And most probably this possibility of trouble in the event of vacancy will become more likely as time passes, for personnel problems are an increasing consideration with tenants and nobody is as insistent on the finer things in life at somebody else's expense as the average clerk. Nevertheless, it seems unlikely that the impact of competition from new, air conditioned buildings will be serious until they represent 10 percent or more of the total available office space.

With respect to question No. 4, existing buildings would never be forced to air conditioning if one of them, or a new building, did not introduce it. Without air conditioned competition, they could hold their rates and let the tenants install individual units or otherwise survive, as they have for the past 50 years. But if new buildings set the pace and finally represent a substantial percentage of the total office space in the city, then the existing buildings may be forced to air condition. Or, if the oldest building elects to modernize and air condition to improve its rates, and its neighbor does likewise, and its neighbor, and so on, then again there would be a situation that would force this feature upon existing buildings.

So much for comments on the first four questions. They are not based on established facts or experience but seem logical in view of what we know with respect to new buildings and the rental market.

Does Air Conditioning Mean Extra Advantages?

Now with respect to question No. 5, "Will air conditioning permit an economic design that will give a new office building advantages other than just the air conditioning itself?"

The answer is unquestionably

"Yes," but to what extent this is true is something not so easily answered. We cannot say, for instance, from our present knowledge, that air conditioning, combined with modern decorative treatment, permits in general a typical floor development that is 5 percent or 10 percent, or any specific percent more efficient than the standard typical floor without air conditioning. This is because our experience has not been adequate to date (either from the standpoint of frequency or time) to permit accepted conclusions.

But such conclusions would be of the greatest value if we had them. An owner's problem of whether or not to air condition a new building would be vastly simplified if he knew that instead of just representing an added cost of $2.50 per sq ft, it permitted a layout sufficiently more efficient that the real net increased investment per square foot of rentable area was only one-half that amount. It has been my effort in preparing this paper to arrive at such a conclusion.

At the start, let us consider a single typical floor. This is always the nucleus of office building analysis, and we cannot consider all the factors involved in an entire building simultaneously. What will air conditioning permit us to accomplish that is otherwise impossible? It will, in conjunction with additional interior treatment, permit us to produce rentable area equivalent to the full lot size except for wall thicknesses, utilities, and possible setbacks required by code. Light courts can be eliminated. We know this is true because it is being done.

Prior to air conditioning, the majority of large buildings had one (or perhaps two) bank floors. These floors contained as much area as could be produced. They were mechanically ventilated and usually the most difficult to rent. Today we see new air conditioned buildings being erected that have 10 or 12 such floors. These buildings have so far been mostly institutional in character, but the space produced would be entirely acceptable to large corporations. No one visiting the new trust department offices of the First National Bank of Chicago or the new offices of the Chicago Title & Trust Co. would doubt the acceptability of large areas, either with or without windows—providing the space is air conditioned, adequately lighted, and properly decorated and furnished.

Air conditioning used to be a luxury adapted to the physical characteristics of existing buildings. As it was further improved, the physical characteristics of new buildings were designed to accommodate air conditioning. Today, not only the physical specifications but their very economics of design are influenced by the development of air conditioning

In those four requirements—air conditioning, lighting, decorating, and furnishing—lies the answer to producing top-grade space of any dimensions in any location whatever, even underground. The first attempts to eliminate windows were, in most instances, unsuccessful. This is not surprising when we visualize buff walls, tile floors, and ordinary light fixtures. Such a floor was "barny" and cold, and the employees in looking about observed mostly the unfamiliar lack of windows. But give them the same floor with soft and varied colors on the walls and columns and with high intensity fluorescent light and an acoustic ceiling and carpeting and drapes, and they are no longer conscious of the lack of windows.

Recognizing, therefore, that we can produce acceptable space with full typical floor development, what are the economics involved? As an illustration of the factors to be considered, I prepared a simple chart showing a standard typical floor development and a corresponding full typical floor development. In these computations made for the purpose of comparing a standard typical floor with a full typical floor, it was of course assumed that the former is not air conditioned and that the latter is air conditioned. It was further assumed that each of the floor developments is typical of a 22 story building in order that the increased number of elevators required for the full development floor may be charged against it. It was also assumed that a story height of 11 ft, 3 in. is practicable for each.

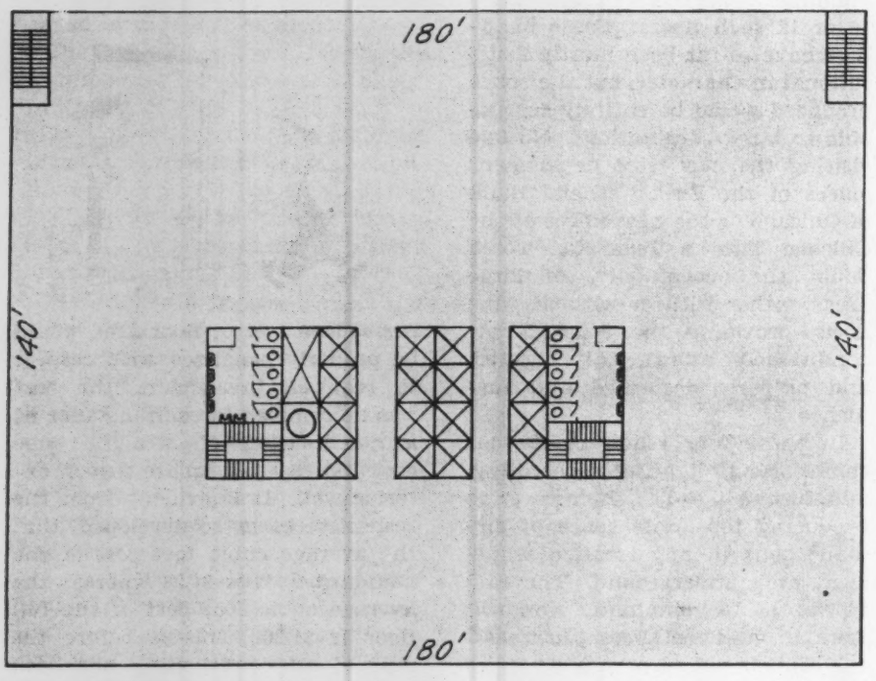
It was then possible to compute the relative cost of the two floors. But in order that the floor with the greater amount of exterior wall

per square foot of floor area would be properly penalized with respect to required investment, the cost was determined in each instance as a combination of straight cube cost and cost per square foot of exterior wall. It is evident from the respective costs, so developed, that the average cubic foot cost of the standard floor is $1.28 whereas the average cubic foot cost of the full floor is $1.20. This is before the cost of air conditioning has been added to the full floor.

The above figures for cost per cubic foot are not to be confused with the average cubic foot cost for a complete building, as they do not reflect the cost of foundations, basements, or loading during construction.

Now, in connection with the full floor development, it is necessary to add the cost of air conditioning and also the cost of fluorescent lighting and acoustic ceilings. This is necessary in order that a prospective tenant would, in each instance, have only his investment in furnishings to make. The cost of interior subdivision can be neglected for comparative purposes as it has been ignored in both instances. On the premise therefore that both floors are usable and the tenant's investment will be equal for either, the tenant will make his choice on the basis of only two factors: his reaction to large open areas as opposed to normal depths of space, and the difference in rent —which presumably will reflect the value or cost of air conditioning.

It might be well at this point to comment on fluorescent lighting. So far, I have referred almost entirely to air conditioning as the feature responsible for a possible new theory of economic design but actually the development of fluorescent lighting goes hand in glove with it—as does the acoustic ceiling, since it can be installed at the time of original construction for



Full typical floor layout, which can be produced complete with air conditioning, fluorescent lighting, and acoustic ceilings for only about 8 percent more than a standard floor without air conditioning and with ordinary lighting

but little more than a hard plaster ceiling (particularly in instances of flush ceiling lights).

I have used a cost for complete air conditioning of $2.50 per sq ft and an extra cost for fluorescent lighting and acoustic ceilings of $2 per sq ft and added these costs to the required investment in the full floor development. With these figures included, a square foot of net rentable area requires an investment of $19.70 in the full development plan as opposed to $18.20 for the standard plan.

This brings us to one of the conclusions I have been attempting to reach—to wit, a full floor development can be produced, complete with air conditioning, fluorescent lighting, and acoustic ceilings, for only about 8 percent more than a standard floor without air conditioning and with only ordinary lighting. I say "about" because this is only one analysis, but the chances are that similar analyses for floor plans of different but not abnormal dimensions would approximate the same result.

What Are the Operating Costs

But there is a second step to the above conclusion before it fully serves our purposes. What are the respective operating costs of standard versus air conditioned space? Again, because this is only a comparative analysis, I utilized the 1947 experience exchange figures for Chicago to find a square foot operating cost, exclusive of fixed charges and taxes, of $1.427 per sq ft per year for the standard floor. For the full floor I used the same figure but added a net cost of 26c for the air conditioning. This was the result of starting with 50c for full air conditioning and deducting therefrom the costs for ordinary heating and ventilating and further deducting 6.8c for elimination of corridor maintenance. This resulted in a figure of $1.687 per sq ft for the full floor. By adding to these operating figures the respective square foot charges for interest, depreciation, and taxes, I arrived at the total square foot carrying cost, or required rent, for each and these figures show, on the basis of 90 percent occupancy, $3.86 for the full floor as opposed to $3.52 for the standard floor.

This brings us to the second conclusion—to wit, a full floor development, complete with air conditioning, fluorescent lighting, and acoustic ceilings, will require about 10 percent more rent than a standard floor without air conditioning.

This latter conclusion would pretty much serve our purpose if we were constructing only five or six story buildings designed for users of bulk space. But such is not the case in connection with a large office building, where the potential tenancy will include many small offices not adaptable to bulk space. Here, a certain proportion, at least, of the rentable area must be designed for use by small tenants. Just how much will always be a matter of judgment and will depend on the city, the design of the building and its location. Figures representing average tenant size and percentage of occurrence are of little value.

Any owner contemplating a large new office building today would certainly design no more than 50 percent of his space as full floor development. I am referring now to the rentable area available for lease to outside tenants. An institution might very well provide full floor development for its own purposes throughout. Neglecting institutional area, therefore, at least one-half of the rentable area produced would be of standard floor development, even though air conditioned. This area will still be best designed if in accordance with the principles of economic layout developed and used by the building planning service of the National Association of Building Owners and Managers. Consequently, our established conception of office building design is not obsolete, but it must now be amplified by a new set of factors and figures applicable to that portion of the building represented by full floor development.

In the foregoing I have arrived at certain conclusions. The approach is necessarily theoretical to a substantial extent, but is leavened, I believe, with practical unit figures. Certainly the basis of computation is open to examination and criticism and if, as a result of the latter, these conclusions of mine are modified, that is desirable.

OFFERS SCHOLARSHIPS IN MILLING ENGINEERING

With funds provided by the flour milling and grain processing industry, the University of Minnesota is now able to offer scholarships for study in milling engineering.

The new scholarships are available to outstanding high school seniors and college students.

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Fig. 1—Unit fabrication of piping comprising 4 x 3 x 2 in. steel loop header for boiler feedwater service, containing a compact grouping of 17 welding end valves

Unit Fabrication of Piping

G. W. HAUCK, manager of engineering sales, Crane Co., Chicago, indicates here—in words and pictures—how integrated welded assemblies of valves, fittings, and pipe simplify and expedite piping installations

UNIT FABRICATION embodies many distinct advantages which should be especially interesting to those who are concerned with the problems stemming from the installation of high pressure and high temperature welded piping.

Unit fabrication is admirably adapted to modern power plant piping and, although it was developed primarily for such service, it is equally adaptable to process piping whenever welded construction and high pressures or temperatures are encountered.

Following a brief definition, the logical approach for this discussion is to relate the background which was responsible for the development of unit fabrication.

Definition of Unit Fabrication

Unit fabrication is a combination of design, materials, and specialized fabricating shop skills, the end product consisting of valves, fittings, flanges, fabricated piping, and other components welded into convenient assemblies, then shipped to users as pre-tested integral units, ready to drop into place in the piping system.

The words of this definition are brief in order to provide space for illustrations which portray the theme effectively. The definition of unit fabrication can be amplified readily by reference to Fig. 1, which is a typical example.

Background of Development

A number of significant developments were responsible for the idea of unit fabrication and have been influential in promoting the trend toward its use.

Piping specifications for central stations and industrial power plants have undergone many changes in recent years. Materials, fabricating procedures, and the techniques of installation have been altered considerably in coping with the wide range of pressures, temperatures, and services—plus the challenging demands of the extremely high pressures and elevated temperatures which are prevalent today. Engineering research and experiments are responsible for new piping materials, particularly in alloys, which capably handle pressure-temperature conditions that would have seemed fantastic little more than a decade ago. In steam services, pressures of 1850 psi and even higher, temperatures of 850, 900, 1000, and 1050 F—and higher—are currently employed. As service demands become more severe, piping materials, fabricating techniques, and installation know-how must and do meet the challenge of more exacting designs and requirements in specifications.

So much for the overall picture

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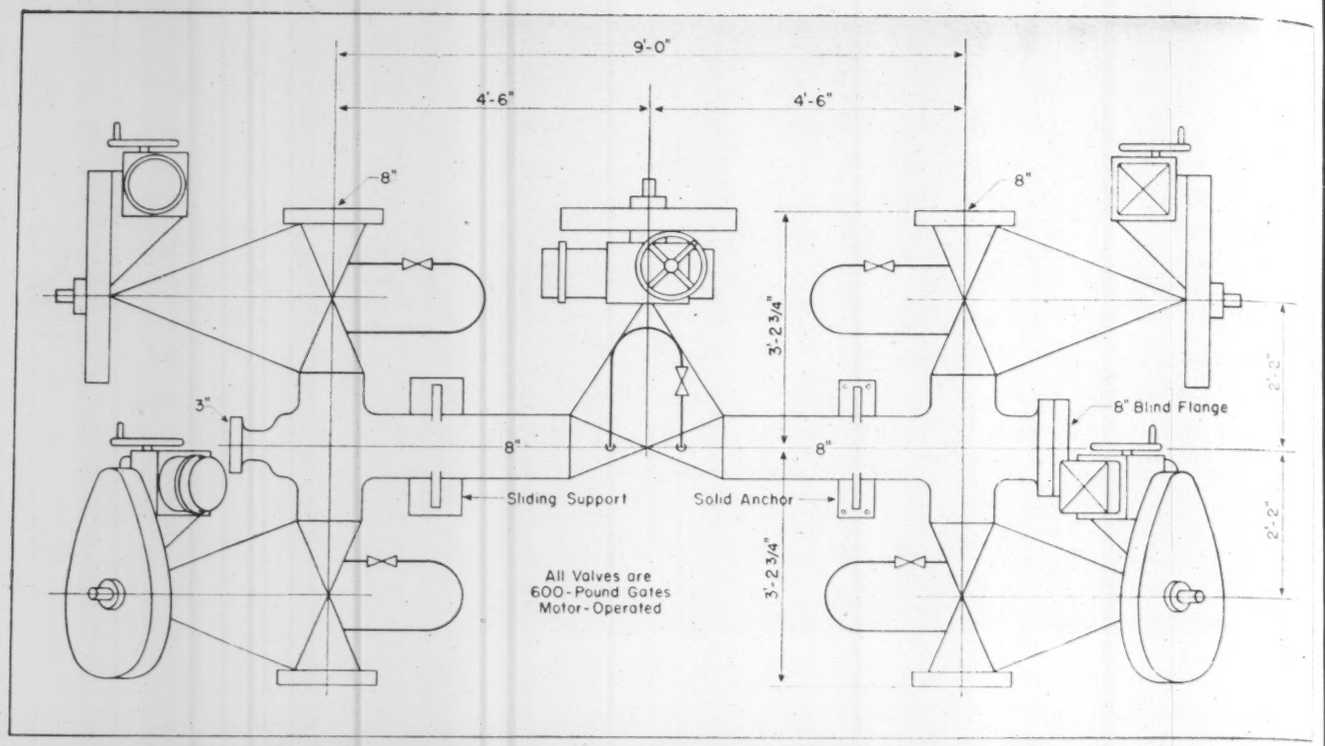
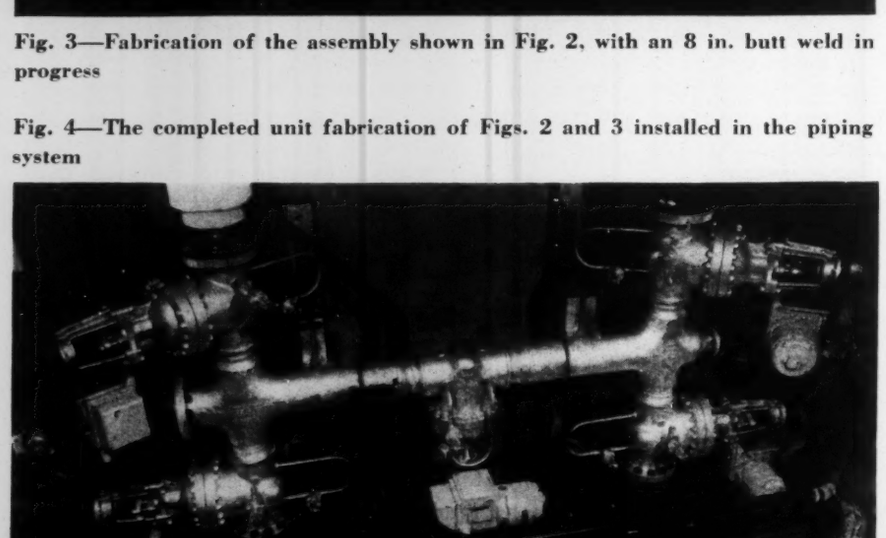


Fig. 2—Elevation of main steam unit fabrication, typical of design trend toward short headers and compact grouping of principal valves

Fig. 3—Fabrication of the assembly shown in Fig. 2, with an 8 in. butt weld in progress

Fig. 4—The completed unit fabrication of Figs. 2 and 3 installed in the piping system



of the influences which have led to the development of new piping materials and attendant procedures for fabrication and installation, then expanded further into the idea of unit fabrication. A brief discussion of the individual influences will be helpful in elaborating this theme.

Piping Design and Materials

The present trend in power plant design is to provide main steam headers which are ample in diameter but relatively short in length, the latter in order to attain compact grouping of the principal valves for boiler, turbine, and auxiliary leads. Similarly, headers for feedwater piping, auxiliary headers, connections and bypasses for pressure reducing and desuperheating stations, other assemblies of valves, fittings, and piping follow this trend. Modern design, therefore, is an important influence.

In the evolution of materials stemming from the employment of higher pressures and temperatures, users encounter such piping materials as carbon-molybdenum (ASTM A-206); ½ percent chrome-½ percent molybdenum (ASTM A-280); 1 percent chrome-½ percent molybdenum (ASTM A-315); 2¼ per-

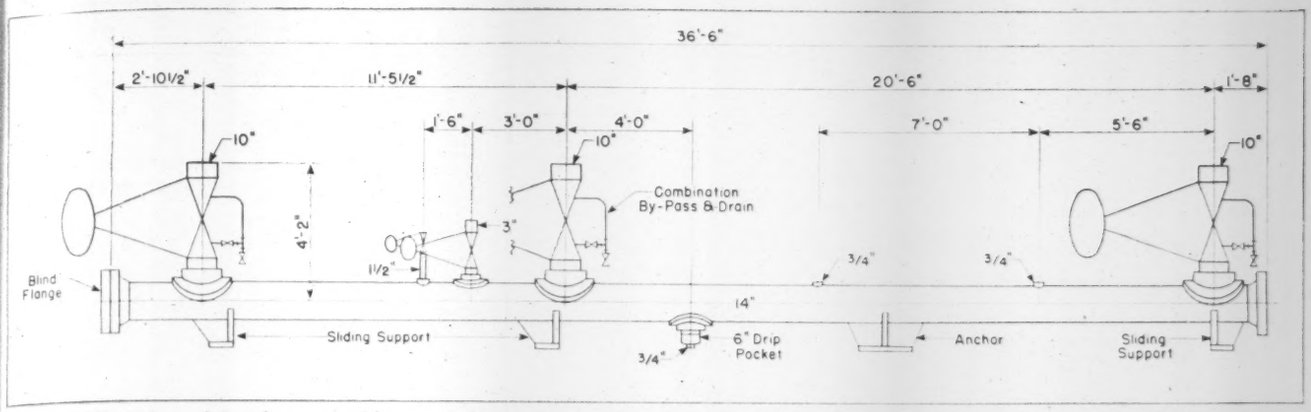


Fig. 5—Elevation of header assembly, unusual aspects of which are described in the text

cent chrome-1 percent molybdenum (ASTM A-213 Gr. T22); other low chrome and high chrome alloys. Equally important are carbon steels with heavy wall thicknesses, of which a good example would be 12 in. schedule 160, A-106 grade B pipe which is 1.312 in. in wall thickness.

This listing is typical but by no means is it complete. These materials, particularly the alloy steels, represent a decided influence in the development of unit fabrication.

Welding has played an important part as a modern tool for making piping joints and in contributing to the efficiency of modern piping. For elevated pressure-temperature services, the installation of welded piping (including valves) is almost universal practice in power plants. Evidence of this is contained in the fact that the newest valves for this service—pressure-seal bonnet—are regularly made with welding ends only. Similarly, the demand for welding ends in conventional valves also has grown. Welding, therefore, is an important influence.

A Logical Outgrowth

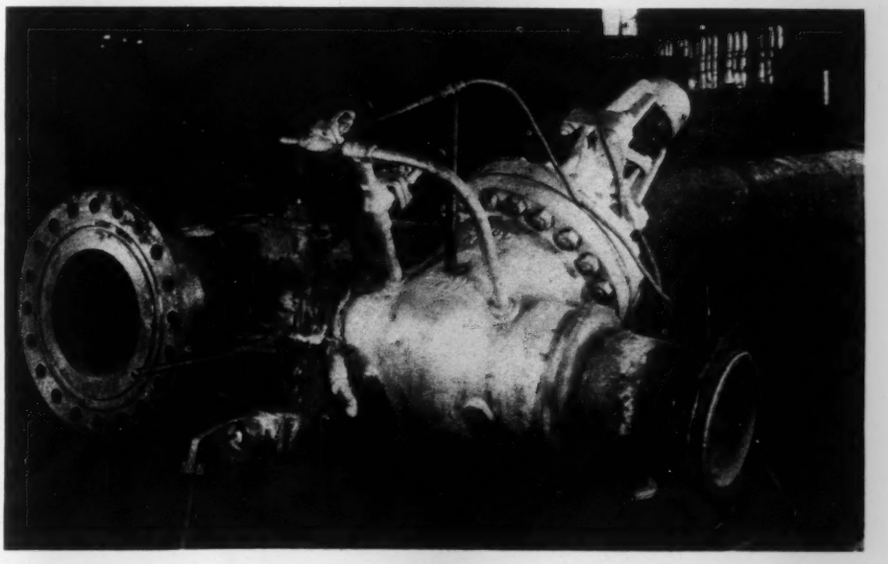
A previous paragraph lists alloy piping materials in the approximate chronological order of their advent in the field of high pressure-high temperature piping installations. No two alloys are exactly alike in all details of handling . . . each requires a separate procedure for fabricating and for welding. These operations become more and more exact and critical in preciseness as the chrome and other alloying elements in the steel are increased.

The fabrication of piping materials made of alloys such as those listed should have the benefit of special skills and equipment—qualified welding procedures, laboratory supervision, stress relieving or heat treatment by the full furnace and local processes, radiographic examination of welds (when required), special cleaning, hydrostatic testing, and others. This involved sequence of operations is best accomplished most economically and with the surest approach to the attainment of the predetermined intent of the design in a modern fabricating shop.

It follows, therefore, as a logical sequence, that the expanding use of alloy piping materials plus the predominance of welding create, in combination, problems which are of

Fig. 6—Completed header of Fig. 5 prior to shipment

Fig. 7—Stress relieving operation on butt weld connecting one of 10 in. valves to welded nozzle. Flanged connection on outlet pipe was cut off after completion of hydrostatic test



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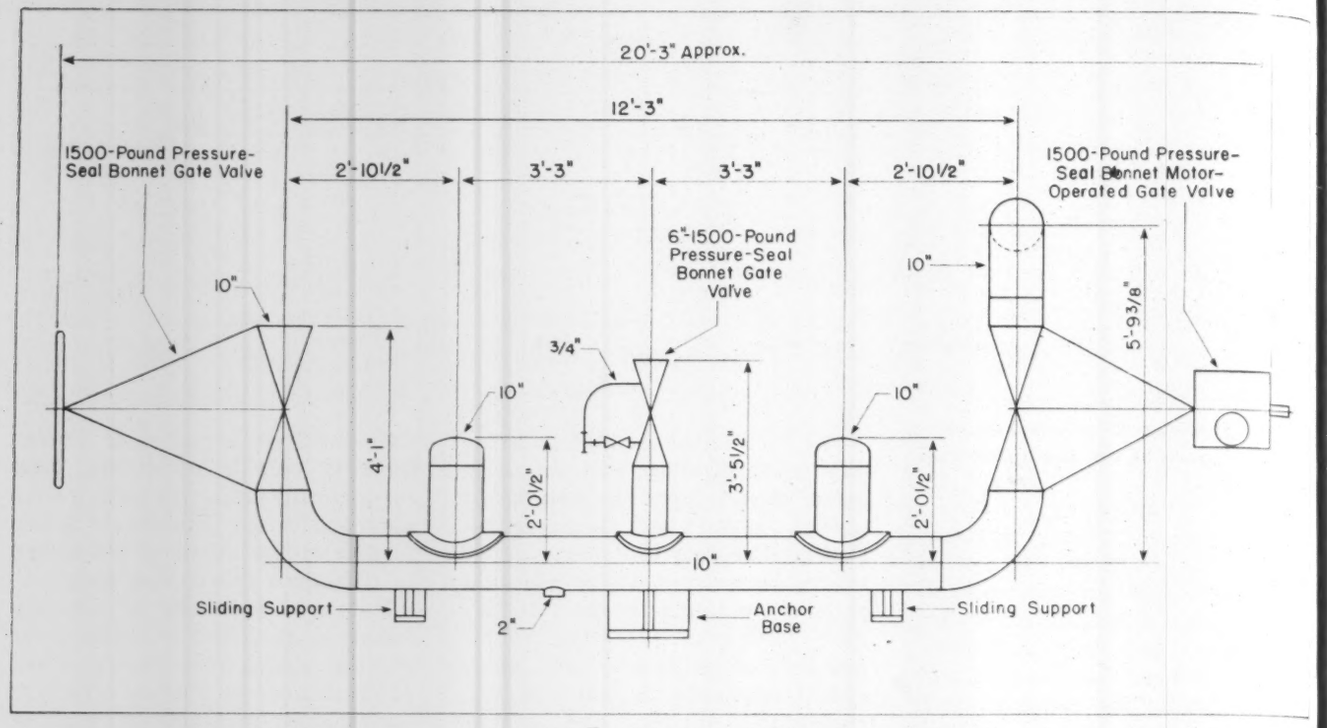


Fig. 8—Elevation of unit fabrication for high pressure-temperature service in a large process plant

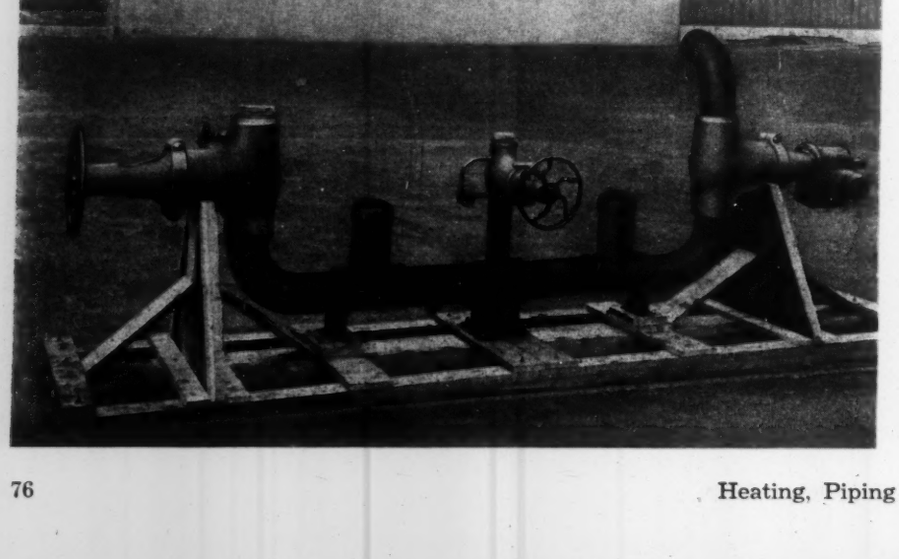
concern to designers and users of such equipment. Consequently, it is accepted practice to purchase alloy piping in prefabricated form from a shop where its production can be engineered to provide headers and other welded assemblies in units of the largest possible size which can be handled in the field. The principal field fabrication is thus confined to butt welds and these are held to a minimum. In some rarer instances, field welding and the attendant operations are eliminated entirely on alloy materials through the medium of a minimum number of flanged joints (see Fig. 4).

It was noted previously that modern design is an important influence in the development of unit fabrication because valves are compactly grouped on headers, etc. Users can profit not only by purchasing prefabricated alloy piping but profit further by having welding end valves, fittings, and the like attached to headers and other assemblies. This reduces further the number of welds to be made in the field and the attendant problems of preheating, stress relieving, etc. Equally important, the welding of valves to piping entails responsibilities that many users are happy to eliminate from field fabrication as much as is possible.

Emphasis has been placed on alloy piping as the major premise in considering the need for unit fabrication. Of secondary but almost equal importance is carbon steel piping of the heavier wall thicknesses and which also incorporates welding end steel valves. It too can be produced advantageously as unit fabrication as may be verified in some of the accompanying illustrations.

Summing up the previous discussions and integrating the three influential developments in 1) design, 2) materials, and 3) welding, unit fabrication becomes the logical outgrowth in the evolution of modern piping.

Fig. 9—Ten inch alloy steel main steam assembly



Specific Examples of Unit Fabrication

Example No. 1—The unit fabrication shown in Figs. 2, 3, and 4 is a main steam header assembly and is typical of the trend in design toward short headers and compact grouping of principal valves, all within easy access from one operating point.

The two upper valves in the vertical runs control flow from the two 8 in. boiler leads; the two lower valves control flow in 8 in. turbine leads. These four valves have one welding end (which is welded to the assembly) and one flanged end for field joints. The welding end valve in the center of the horizontal run provides means for cross-

connecting the two main vertical headers.

The fitting at the left is a special 8 x 8 x 8 x 3 in. cast steel cross; the 8 in. ends are beveled for welding and the 3 in. opening is flanged to provide an auxiliary steam connection. The fitting at the right is a special 8 x 8 x 8 x 8 in. cast steel cross; three ends are beveled for welding and the other end is flanged and fitted with a blind flange. Each fitting has a supporting pad welded on the back—one pad is a solid anchor, the other is a sliding support. The five valves are 8 in., 600 lb, cast steel, motor operated, gate valves.

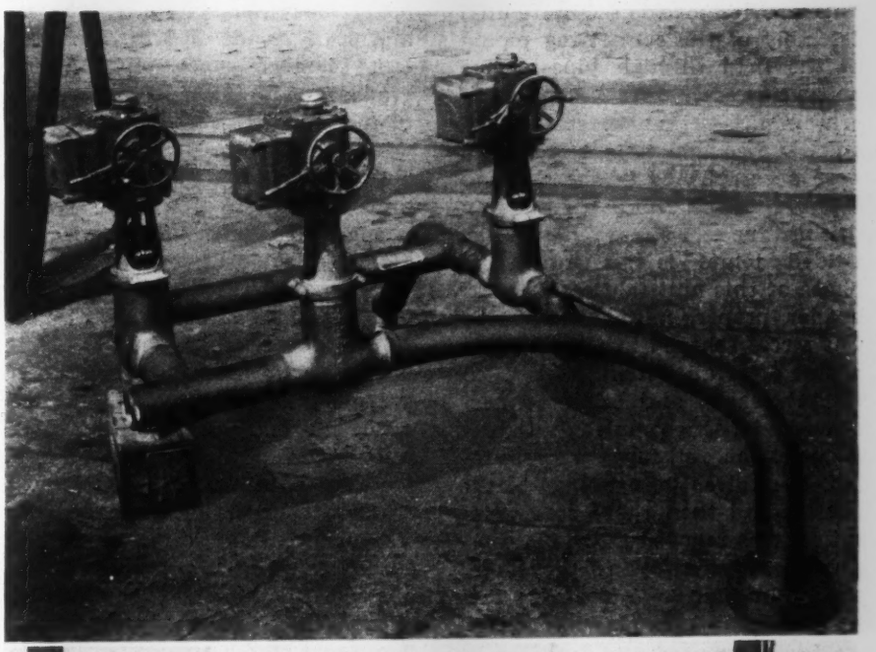
This unit fabrication was completely welded, stress relieved, cleaned internally by sandblasting, and hydrostatically tested in the shop, then shipped as a one-piece unit. This unit was produced for main steam service at 550 psi and 825 F and was tested in the shop at 1100 psi, hydrostatic. The total weight is 12,330 lb.

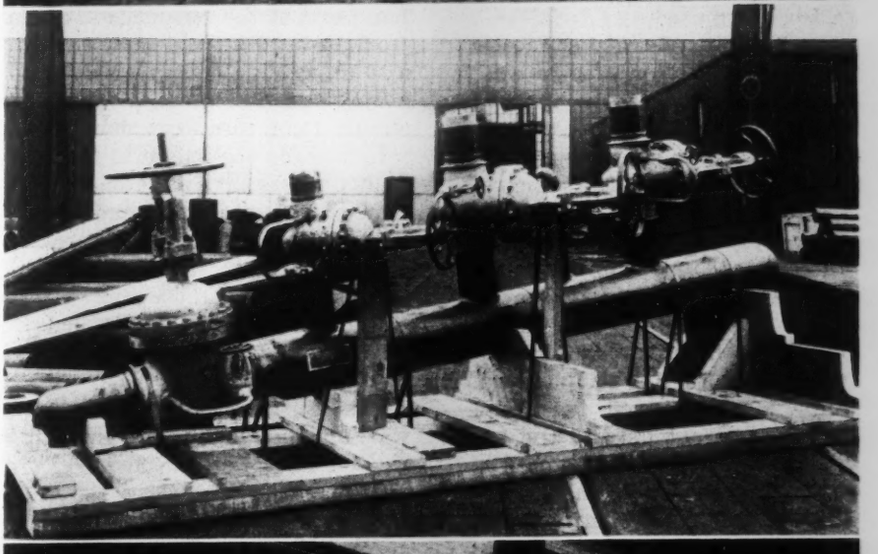
All welds on the alloy materials were made in the shop and field welding of alloy materials was eliminated by using a minimum of flanged joints, as shown.

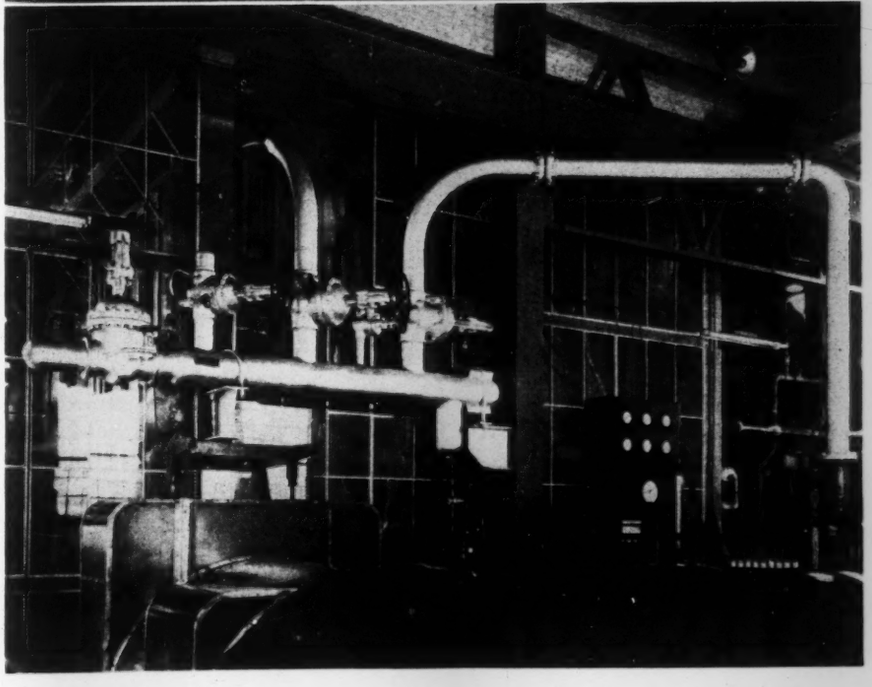
Example No. 2—The unit shown in Figs. 5 and 6 has some unusual aspects which are worth noting because the advantages of such fabrication are exemplified particularly well.

This main steam header, 36½ ft long, is made of 14 in., schedule 80 (0.750 in. wall thickness) A-106 seamless steel tubing with 600 lb forged steel welding neck flanges at the terminal ends. The five reinforced welded nozzles are equipped with 600 lb steel welding end gate valves of the sizes shown in Fig. 5. This header also has a 6 in. reinforced welded drip pocket, some miscellaneous welded tapped bosses, and four welded supports of 1 in. plate.

Fig. 6 shows the completed unit fabrication prior to shipment. The drawing and the photograph show short sections of pipe welded to the outlets of the 3 in. and 10 in. valves.







***Top*—Fig. 10—Six inch carbon steel feedwater assembly. *Center*—Fig. 11—Unit fabrication of main steam header with valves for service at 415 psi and 750 F. *Bottom*—Fig. 12—The unit of Fig. 11 after it was installed and the connecting branch lines were erected**

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This was designed to facilitate final assembly of the connecting piping in the field through pipe-to-pipe butt welds. The more difficult tasks of welding pipe to alloy steel valves and subsequent stress relieving were accomplished in the shop.

The shop procedure followed in this instance for stress relieving the welded joints is an interesting phase of this unit fabrication. The header proper, minus the valves, was stress relieved in a furnace as a unit after all welding of nozzles, flanges, bases, and other connections had been completed. Subsequent to this full furnace stress relief, the valves were welded to the nozzles and then these butt welds were stress relieved individually by a local stress relieving process as shown in Fig. 7. A portable furnace which clamps around the butt weld is being used.

Fig. 7 shows a flanged connection on the short section of pipe which has been welded to the outlet of the 10 in. gate valve, yet this flanged end does not appear on the finished header in Fig. 6. The reason for this presents another interesting feature of the inherent advantages of unit fabrication. A temporary lap was provided for the pipe on each of the valved outlets solely to permit hydrostatic testing of all welds in the completed assembly. These lapped ends subsequently were cut off and the ends were machine beveled for field welding as shown in the illustration of the completed assembly, Fig. 6.

This unit fabrication was produced for main steam service at 600 psi and 750 F and was tested at 1200 psi, hydrostatic. The total weight is 12,200 lb.

Example No. 3—Figs. 8, 9, and 10 are fine examples of unit fabrication, in alloy steel and carbon steel, both for high pressure-temperature service in the new power house for a large midwestern process plant.

Figs. 8 and 9 show a 10 in. main steam header assembly made of schedule 160, ½ percent chrome-½ percent molybdenum alloy steel pipe and fittings, 1500 lb gate valves, for service at 1600 psi and 900 F. This unit fabrication was tested hydrostatically, pickled and sandblasted, and inspected for boiler code service. Total weight is 8700 lb.

Fig. 10 shows an assembly for boiler feedwater service at 2000 psi and 606 F, made of 6 in., schedule 160, seamless steel pipe, A-106, grade B, with 1500 lb alloy steel, motor operated, gate valves. Total weight is 4150 lb.

Example No. 4—Fig. 11 shows unit fabrication of a main steam header with valves for service at 415 psi and 750 F.

The main header is 14 in., schedule 80, seamless steel pipe with 2½, 6, and 8 in. welded nozzles, each with a welding end gate valve. Each valve has a short section of pipe welded to it to permit pipe-to-pipe butt welds in the field. All welds were stress relieved.

Near the right hand end of the header is a 10 in. welded drip pocket with a 1 in. drain connection; just beyond, the end of the header has a welded end closure. The left hand end of the header is swedged from 14 to 10 in. and is fitted with a 10 in. welding end gate valve and a short section of pipe with end closure for future extension.

In welding the valves to the four welded nozzles at an angle, exact dimensional accuracy had to be maintained in order to provide clearances and conform to structural limitations in the plant where this header was to be installed.

The total weight of this unit fabrication was 5000 lb.

Fig. 12 shows this unit after it was installed and the connecting branch lines were erected.

Limitations in Size

The only limitations to the size of unit fabrications are the dimensional limits imposed by facilities for shipment, or the dimensional and structural restrictions at the project site. In short, any assembly which can be transported and handled into position in erection can be produced by qualified shops as unit fabrication. However, whether units are large or small, they possess equal advantages.

Shown on the front cover of this issue is an excellent example of a short header with a compact grouping of valves. Components of this unit fabrication include 12 in., schedule 80 pipe; 8, 6, 5, and 3 in. welded nozzles and steel valves: ¾ in. valved drain connections with 1¼ in. header. There is a total of 19 valves, and the total weight is 4800 lb.

BIG BUILDINGS USE CONDUIT SYSTEMS

The 42 story skyscraper now rising at 1407 Broadway, in New York's Times Square district, will be completely air conditioned by a conduit system, the largest such installation in the world, according to Cloud Wampler, president of Carrier Corp.

Thus four of the great skyscrapers now under construction in a comparatively small area in midtown Manhattan will use this system, giving individual occupants complete control over their own indoor weather. Contracts were signed earlier this year for similar installations in the 39 story Secretariat building of the United Nations, the 36 story office building at 100 Park Ave., and the 25 story Mutual Life Insurance Co. building at 55th and Broadway.

At 1407 Broadway, space savings through the concentration of air handling equipment and through the use of small steel conduits for moving conditioned air will amount to some 57,000 sq ft of rentable space, Mr. Wampler said.

More than six miles of small conduit will be used to carry conditioned air at high velocity to all outside rooms of the building. Also, the installation will be unique in its handling of the interior zones. Conduits will be used to bring air up to the interior zones and ductwork will be used only for the horizontal movement of air in comparatively small areas on the different floors.

The conduits will be paralleled by small pipes carrying chilled water in summer and hot water in winter. Both air conduits and water pipes run into individual units in each outside room, permitting occupants to dial their weather.

Refrigeration for summer air conditioning will be furnished by two centrifugals installed below ground, with cooling capacity "equal to the melting of 120 box cars full of ice" each 24 hours. More than 70,000,000 lb of steam will be used annually for air conditioning, heating and hot water.

Architects are Kahn and Jacobs; consulting engineers, Jaros, Baum and Bolles; the general contractor, J. H. Taylor Construction Co., and the mechanical contractor, Raisler Corp.

Direct Fired Units Heat Big Steel Mill

CHARLES P. CRYER, field engineer, machinery div., Dravo Corp., Pittsburgh, describes the installation of six 2,000,000 Btu direct fired heaters burning a mixture of coke oven and blast furnace gas for heating a building 876 ft long, 105 ft wide, and 55 ft high to the bottom chords of the trusses. . . . Three smaller heaters of the same type are installed in the structure housing the steel mill's oxygen generating equipment

HIGH CEILINGS and expansive areas of undivided floor space make mill type structures hard to heat. Maintaining comfortable temperatures for personnel in such buildings is a problem because large volumes of warm air rise to the upper stratum, out of the "working zone." Moreover, loss of heat to the roof may result in excessive fuel consumption.

During the past winter, however, the problem was solved at a large steel plant by using six direct fired space heaters that operate on the principle of warm air recirculation in the working zone. In effect, the heaters create a comfortable "blanket" of warm air in the space from the floor to about 12 ft above the floor. The heating equipment is fired economically with a mixture of coke oven and blast furnace gas.

The building is a standard mill structure 876 ft long by 105 ft wide. There are no partition walls dividing the floor area. Height to the bottom chord of the truss is 55 ft and it is an additional 46 ft to the peak of the monitor roof. Both sides of the monitor have top hung continuous sash windows 6 ft high. Each side wall also has continuous 6 ft windows its entire length. Walls are of brick and metal siding. Each of the 30 bays has a roof ventilator.

Six 2,000,000 Btu Heaters Used

On the basis of standard methods of calculation, heat losses for this large structure were figured at approximately 21,500,000 Btu per hr with a 40 deg temperature rise and with three air changes in the northern third of the building and one air change in the other two-thirds.

Despite the large calculated heat loss, it was determined that the six direct fired heaters, each with an output of 2,000,000 Btu per hr, could maintain satisfactory temperatures in the structure because of their "heat blanket" principle of operation. These self-contained heaters draw air from floor level, warm it, and then discharge it through overhead directional nozzles 12 ft above the floor. Each heater handles approximately 22,000 cfm of air and discharges through nozzles at a velocity of approximately 2000 fpm. Thus, large areas are covered without blowing heated air directly on personnel or using ductwork. The recirculation method also tends to keep warm air from rising rapidly to the roof. Air from the floor is drawn to the intake grilles in the heater base in large quantities but at relatively low velocity to minimize drafts. A 20 hp motor in the base of each heater powers the double width centrifugal fans that draw in the air and force it over the stainless steel combustion chamber.

Although temperatures along the eastern seaboard where the plant is located were not very low last winter, experience so far with this heating system indicates it will provide satisfactory comfort during normal winter weather in the region, which is in a 0 F design zone.

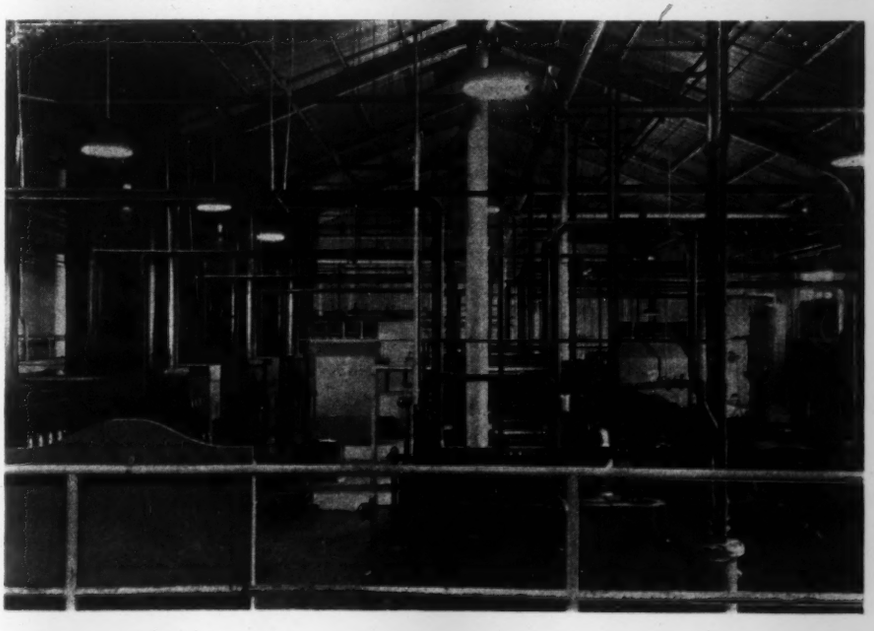
The six heaters are located so as to provide a warm air blanket for the entire working area. Four are spaced about 195 ft apart along the west wall, discharging toward the east wall. One is positioned in the center of the north wall, and one is in the center of the south wall.

Operations in the building include cold milling of sheet, skin passing, tempering, shearing, scrap baling, and roll grinding and storage. There are three cranes operating 40 ft above the floor. Two are 40-ton capacity and one is a 75-ton crane. Production consists of general sheet used for automobiles, refrigerators, and similar products.

Mixture of Coke Oven, Blast Furnace Gas

Use of the mixture of coke oven and blast furnace gas to fire the heaters necessitated installation of

Three direct fired heaters are used to keep the oxygen generating building at 70 F



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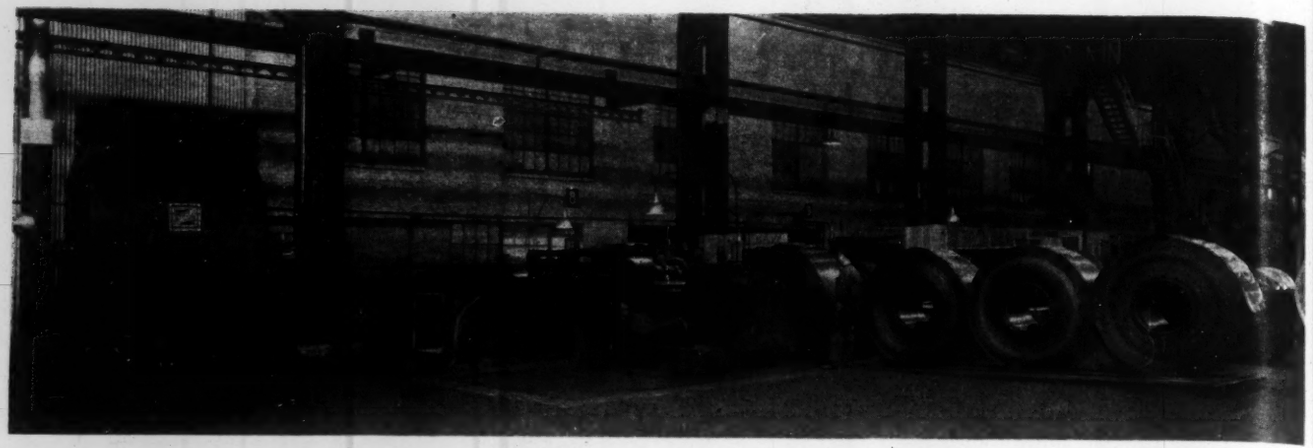

One of the six direct fired heaters is shown at the left of this view. Air drawn from the floor is warmed and discharged at 2000 fpm velocity through nozzles 12 ft above floor level

stainless steel main and pilot valves to resist the corrosive effects of the sulphurous fuel. Special access plates were fabricated for the exhaust fan scroll for easy cleaning. The fan motor in the heater base was totally enclosed to keep out dust and dirt. The motor and shaft bearings are in the path of the intake air stream and so are kept cool.

The gas mixture used is supplied at a pressure of 10 psi and is rated at about 500 Btu per cu ft. It contains about 450 grains of hydrogen sulphide per 100 cu ft. The analysis of this gas showed the following properties: Carbon dioxide (CO_2), 2.9 percent; oxygen (O_2), 0.6 percent; cyclo-propane (C_3H_6), 2.8 percent; carbon monoxide (CO), 8.1 percent; methane (CH_4), 26.8 percent; hydrogen (H_2), 47.2 percent; nitrogen (N_2), 11.6 percent.

The stainless steel combustion chamber, standard in these heaters, resists corrosive attacks of this gas and its combustion products. Moreover, the chamber does not require refractory lining and permits rapid transfer of heat from flame to air.

To achieve maximum utilization of the heat produced within the combustion chamber, the hot gases are moved to the exhaust stack through two staggered banks of economizer tubes that intersect the air stream flowing in through the heater base. These tubes have inside swirlers that force the gases to wipe the tube walls which provides transfer of their heat value to the air.

Besides their use for space heating during cold weather, the heaters can be employed during the summer months for ventilating by operating their fans.

Simplicity of installation was another factor taken into consideration by the steel company's engineers who worked on this project. The heaters needed only a power line, fuel piping, and vent stack to be installed. They are mounted directly on the wood block floor of the mill building.

Oxygen Generating Building Heated

In addition to these six heaters, the same company uses three smaller ones (1,000,000 Btu output capacity) to maintain a uniform temperature of 70 F in a new structure housing the steel mill's oxygen generating equipment. In this building, 100 ft long by 40 ft wide by 20 ft high, some 7,000,000 cu ft of oxygen is generated monthly. Built of aluminum siding on a steel frame, the structure must be kept warm to prevent freezing of caustic soda in eight 38 gal tanks located along one wall. The heaters in this building were equipped with special motors, controls, and relays because the power supply enters at 550 volts, 25 cycles.

ENVISIONS NEIGHBORHOODS WITH VARIETY OF HOUSING

Families whose space requirements change over the years as their numbers grow and diminish won't have to move from one vicinity to another and break ties of friendship under a plan of "neighborhoods with a variety of types of housing at varied rental levels" envisioned at the 96th annual meeting of the American Society of Civil Engineers. Louis B. Wetmore, executive director of the Providence Redevelopment Agency, detailed work under way in Rhode Island's capital in planning a residential community of 1200 homes to house 5000 persons, with residences ranging from apartments to group housing and single family dwellings.

"The requirements of an American family change rapidly," Mr. Wetmore said. "A family of two starts with minimum space requirements. For 10 or 15 years the home expands; it then contracts for a like period until it again has to meet the original requirements for a family of two. Segregation of apartments in one section of the city makes it necessary for a family as it grows or contracts to move about and break its ties with a neighborhood and friends of years standing. This could be obviated by providing a number of different types of housing within the neighborhood.

"The variety of housing types should be accompanied by a variation in rental values; otherwise, the young, growing family, hard pressed financially, might not find housing which it can afford in the same area with parents and older friends. A segregation by income levels is as unsatisfactory as a segregation by housing types. This does not mean, of course, a mixing of one-family houses, valued at $25,000 with apartment structures renting for $50 a month. It does mean that within an area nearly a mile long, and with a population of 5000, there is room for apartment developments in one section, group housing in another, and single family housing in still a third. Moreover, some land by its geographic location or because of subsurface conditions is better suited to apartments or group housing than to a single family development."

District Heating Developments Reported on at NDHA's Meeting

STEAM LOAD on the lines of the Rochester [N.Y.] Gas and Electric Corp. has been increasing steadily. Up until 1946, the steam supply for a large part of the downtown district was furnished from a steam station known as No. 8, through a distribution main operating at 200 psi and 500 F. In that year, growth of the steam business necessitated the taking of some corrective steps and the building of a mile-long, 10 in., 650 psi steam tie-line was agreed upon to deliver to the distribution system up to 200,000 lb per hr of steam from a steam-electric station.

Since steam from this combination plant costs less to deliver into the distribution main than steam from station No. 8, the former source is used whenever steam is available. No. 8 is shut down entirely in the summer. This makes it easier to make repairs and provides a source of plant operators for other plants during the vacation period.

Conditions at the point where the tie-line delivers its steam to the distribution main made necessary the erection of a pressure reducing and desuperheating station there.

George M. Johnson, of Rochester Gas and Electric, explained the reasons for the line and the operation of the station at the recent 40th annual meeting of the National District Heating Association.

He said that the pressure regulating valves, each with a maximum capacity of 100,000 lb, which may be operated either manually or automatically, reduce the pressure of the steam.

The steam then passes to the desuperheater which is of the direct contact type using water from the city system, which is first softened in a zeolite softener, heated in a heat exchanger, and stored in a tank. A water level controller, actuated by the height of the water in the bottom of the desuperheater, controls the operation of duplex water pumps. Waste heat is recovered by a flash tank and heat exchanger.

Mr. Johnson said that when the equipment first went into operation, there had been some control difficulties but a modification in design had overcome this. At present, some trouble with scale is still to be corrected.

New Boiler Requires Less Floor Space

District heating plants are often erected in densely built up areas where building plots are not only hard to find but expensive to purchase. Therefore, it is very desirable to design a plant which is capable of producing the greatest possible amount of steam per square foot of ground area.

R. G. Felger, of The Detroit Edison Co., explained at the meeting how his company had recently made an important advance along these lines. In November 1948 they put into service at the old Willis Ave. heating plant a new boiler designed to produce for an indefinite period 200,000 lb per hr of steam at 160 lb gage pressure and after some modifications 250,000 lb per hr, all in a space originally planned for a boiler to have a maximum steaming capacity of 95,000 lb.

The bent tube boiler is equipped with water walls and a double ended, seven retort, underfeed stoker. The rest of the equipment consists of economizers, a dust collector, a steam flow-air flow meter, and combustion control. Controls are automatic and air actuated. Each half of the boiler has its own feedwater regulator and economizer. The gases pass through the multiclone dust collector. The only brick work is a small section over each stoker.

This being a "tailor made" installation, there are four different sizes of tubes. The economizers are installed above the boilers and beneath the dust collectors.

JOHN F. COLLINS, JR., secretary-treasurer of the National District Heating Association, summarizes the reports and papers given at the NDHA's 40th annual meeting, which was held at Swampscott, Mass., in this article prepared exclusively for HPAC

New Generating Capacity at Cambridge

Due to the rapid postwar increase in the electric load of the Boston Edison Co., that utility was no longer able to supply its neighbor, the Cambridge Electric Light Co., with half of its kilowatt requirements at as an attractive price as it had formerly done.

The Cambridge company, therefore, decided to build its own plant to supply its own requirements and to locate it on an ideally situated vacant plot of its sister company, the Cambridge Gas Light Co., in East Cambridge, adjacent to the Charles River basin. This is an industrial district whose plants require not only electric power but steam for processing. Another associate company, the Cambridge Steam Corp., had for some years been supplying their steam requirements from the gas works plant.

R. D. Stauffer of the affiliated utilities described the combination steam heating and electric generating station, known as the Kendall Sq. station, which was erected.

Initially there are two water cooled boilers with a rated capacity of 200,000 lb per hr each and one extraction, condensing type 20,000 kw turbine-generator unit; also a

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superheater, an economizer, an air preheater, an electrostatic precipitator and a condenser. The plant is designed for operation at 1300 psi at the turbine throttle and 900 F total steam temperature.

It is equipped to burn either pulverized coal or fuel oil. There are two pulverizers for each boiler. The Cambridge city water used is treated in a hot process water treating plant. Two deaerating feedwater heaters are included in the equipment.

When the first 700 ft length of the proposed 3000 ft reinforced concrete, rectangular, 4 ft, 10½ in. by 7 ft, 0 in. tunnel—to connect the plant to the steam system—was found to have cost much more than estimated, the remaining 2300 ft of mains were encased in 5 ft diameter, precast, concrete pipe —except on street crossings, where flat conduit with removable cover at some points was laid.

This combination structure now contains one 16 in. steam main and one 8 in. return main and has space for another 16 in. steam line. The steam pressure is 200 psi.

Effect of Humidity on Steam Load

Just what effect relative humidity at various outdoor temperatures has on the peak load of the New York Steam Corp. was the subject of investigation during the past year. In the absence of Thomas P. Brown, Jr., author of the paper, R. C. Hine, of Baltimore, presented the results of the study.

At a previous annual meeting, Mr. Brown had explained that to estimate steam consumption, correction factors for (1) day of the week, (2) thermal lag, (3) wind velocity, (4) heated cube, and (5) humidity to the average base peak send-out load of the company for various 6:00 a.m. outdoor temperatures are applied. Thereafter, some had contended that since an increase in relative humidity results in the greatest comfort being experienced at a lower dry bulb temperature, a lighter steam load might be expected with an increasing relative humidity.

The correction curve applied in New York for relative humidities produces a negative correction when they are under 60 percent and a positive one when they are above 60 percent.

In this paper, Mr. Brown assembled data for 55 days of the past heating season and showed that in 72.8 percent of the time their corrections were valid.

He offered the explanation that a damp atmosphere at low temperatures has a penetrating effect and produces a feeling of coolness while at high temperatures moisture in the air causes an uncomfortably warm sensation. He added that the determining factor on the peak load is not how the occupant is going to feel when the comfort zone is reached but how he feels when he first turns on the steam.

New Practices in Heat Distribution

Five papers on the distribution of steam and one on the subject of high-temperature water were presented by George K. Saurwein, New England Gas and Electric Association, chairman of the distribution committee, and his associates.

By way of introduction, Chairman Saurwein said that high fuel cost, increasing labor difficulties, and a more active emphasis on smoke abatement are resulting in an increased demand for district steam service. Since the steam lines of most utilities are now well loaded, it is certain that many extensions will soon have to be built. As the high cost of such construction has been one of the chief deterrents to the expansion of district heating in the past, he said, the report this year is a reappraisal of present practice with emphasis on developments in recent years.

Up-to-date distribution practices of 12 leading steam utilities had been investigated and were reported upon by Frank J. Schlachter, The Detroit Edison Co. Some of the developments to improve construction or reduce costs are:

1) The use of expansion bends to eliminate manholes.

2) The use of corrugated steel inner forms in conduits.

3) The completion of pipe construction in long sections above ground before lowering into trenches.

4) The reduction of air space and wall thickness in box type conduit.

5) The use of ⅜ in. copper bands to hold insulation on pipes.

6) The making of more careful preliminary surveys and greater efforts to cooperate with construction forces to eliminate unnecessary work.

7) The more extensive use of mechanized equipment.

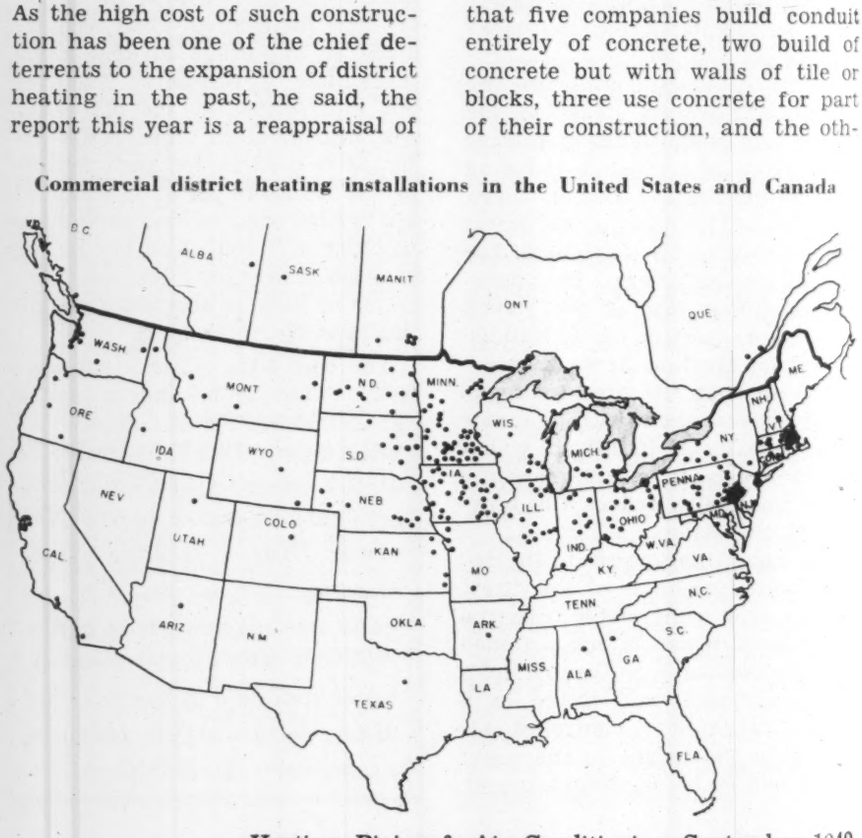
8) The use of 10 ft long prefabricated pipe units to decrease pavement removal.

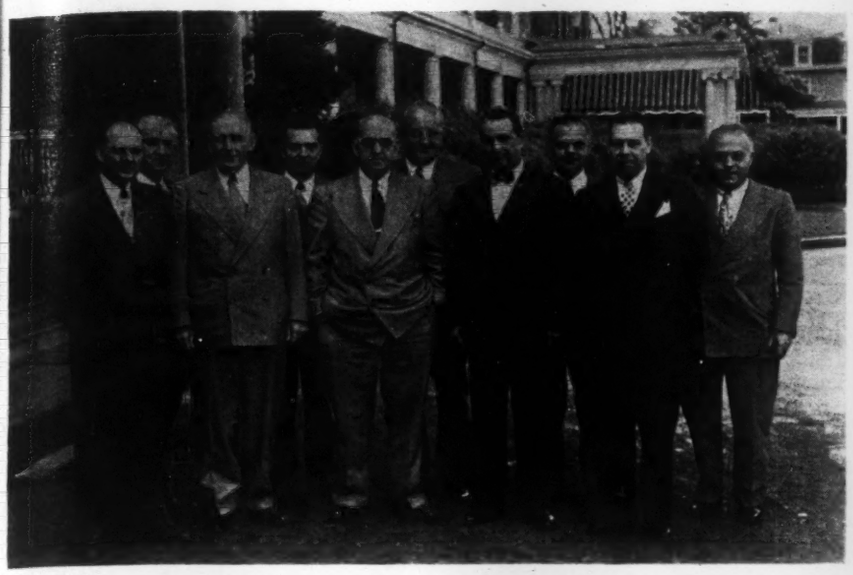
9) The use of stainless steel pipe supports to reduce maintenance.

10) The providing of manhole roof vents and larger manholes to facilitate maintenance.

Mr. Schlachter's report indicated that five companies build conduit entirely of concrete, two build of concrete but with walls of tile or blocks, three use concrete for part of their construction, and the oth-

Commercial district heating installations in the United States and Canada





Officers and directors of the NDHA: George H. Tuttle, first vice president; Henry L. Martin, past president; John F. Collins, Jr., secretary-treasurer; F. Lee Rapson, director; Percy A. Hyde, third vice president; Harold W. Coombs, director; David W. Loucks, president; Charles W. Deeg, director; Alfred T. Veness, second vice president; and A. R. Mumford, director. Directors John Davis and Robert D. Martin were not on hand for this photo

ers use prefabricated conduit. Six utilities build conduit without underdrain while two others specify it.

Six companies reported that they build all or part of their manholes of concrete and a similar number said brick. Two use a combination of these materials. Another company reported it uses cement block in some of its manhole construction.

Little uniformity was reported as to the type of pipe support specified or as to the spacing of such supports. Some companies reported the use of slip type supports, others the use of roller supports; some with and some without saddles. One company specifies supports in the form of stainless steel fins welded along the horizontal centerline of the pipe and resting on concrete pedestals. Spacing of supports varies from 8 to 30 ft, with 15 ft the most popular interval. Most utilities reported that they use alignment guides.

On the subject of line location, nearly all companies said they selected the most practical positions for their lines. Two said they preferred them below sidewalks while one said this was their last choice.

Six companies always contract for their distribution work, five contract for it sometimes and at other times make their own installations. The remaining utility does all its own distribution work.

Recommended cross-sections for insulating concrete types of conduit were described by Paul Chenzoff, Philadelphia Electric Co. His paper also included a table of properties such as densities, water absorption, and heat conductivity for two materials.

Prefabricated steam main conduits were reported upon by Vernon J. Suche and J. C. Haroldson, respectively of the Union Electric Co. of Missouri, St. Louis, Mo., and the Duluth Steam Corp.

The authors had asked manufacturers of conduit to comment on factors such as the following in connection with their products: pipe material, pipe supports, installation, anchors, conductivity, conduit material, waterproofing, expected life, shape, underdrainage, range and condition of use, method of fabrication, insulation material, and strength.

The advantages claimed by the manufacturers of conduits are:

1) They reduce or eliminate construction details that have been of concern to designers of underground steam mains for years.

2) They reduce construction joints to a minimum and such joints as these have special provisions to make them watertight—something difficult to attain in other construction due to expansion and contraction. Also, the use of drain tile usually becomes unnecessary, which represents a saving in material, excavation, and installation labor.

3) They provide a means of guiding the pipe throughout its length.

4) They reduce field work on anchors, ells, tees, expansion loops, and waterproofing, which is very desirable especially in congested areas.

5) They permit the excavation of narrow trenches.

6) They pass through smaller spaces.

7) They can be used with any type of manhole and any kind of expansion joint.

However, being "tailor-made," if an unexpected obstruction is met in a congested street, it may be necessary to refabricate on the job. Also the heat losses generally are greater since the thick walls are absent.

Recently (in Cambridge, Mass.) 1142 ft of 8 in. steam main of the insulating concrete type of construction was installed under an unpaved sidewalk except at street crossings. F. G. Davis, Negea Service Corp., described the operation and gave an analysis which showed the cost to be $27.07 per ft including such items as excavating and backfilling, manholes and anchors, pipe and fittings, expansion joints, insulation, engineering, supervision, insurance, etc.

High Temperature Water Heating

Paul L. Geiringer, American Hydrotherm Corp., New York City, talked on high temperature fluid heating. He said that high temperature water as a heat carrier has advantages not only over steam but also over all other known heat transfer fluids up to 1200 F. He said that 400 F is about the economical high temperature limit for water. Mr. Geiringer claimed system losses are less with high temperature water, pipe lines can be smaller, more satisfactory generating plant operation can be attained, and greater customer satisfaction will result. He did not advocate changing over existing district steam systems.

Messrs. F. J. Schlachter, E. T. Smith, and G. D. Winans, of The Detroit Edison Co., prepared a pa-

per describing the renewal of 1350 ft of 16 in. line. The problem was whether to completely tear out the old line which was leaking and replace it with one of the latest Detroit standard or to make use of the floor and sidewalls of the existing conduit, replace the pipe, and reinsulate with cell concrete. The latter plan was selected only after a comparison of estimated costs and tests of laboratory lines built for this purpose to compare heat loss from the standard conduit with that of the proposed reconstructed line.

What Heating Will Go in New Buildings

What thought is being given by owners, architects, and engineers to the heating problems of buildings soon to be built? The commercial relations committee—under the chairmanship of Albert F. Metzger, Allegheny County Steam Heating Co., Pittsburgh—decided some months ago that it would be valuable to know what to expect in new buildings and also it might be stimulating to those questioned. Accordingly, members of the committee interviewed the prospective owners of new buildings, their architects, and engineers in six cities about building construction, air conditioning systems, and temperature controls.

Building owners in many cases are not familiar with the latest developments but depend on their architects and engineers to specify the best in equipment and materials for comfort within the limits of their pocketbooks. Cost is the all-important consideration and very often building size and equipment selection must be modified to decrease cost. What goes in meets the minimum standards but does not entirely satisfy the owner and his advisers. He must forget many features, all of which he wants, in many cases because of the cost. Occasionally, he makes preparation for future improvements when prices may be lower.

Miss Clara H. Zillessen, advertising manager, Philadelphia Electric Co., gave NDHA members advice on why, where, and how to advertise their service.

Miss Zillessen said steam sales can be increased by an intelligently planned advertising campaign carefully coordinated with the sales effort. More business can be secured more quickly. Proper advertising locates prospects and converts half-hearted ones into lively ones. Salesmen do not find their prospects entirely "cold." Advertising prevents interest lag between calls and it saves salesmen legwork.

She pointed out that due to the nature of the business, the market is restricted. If a sale is not made, years will pass before obsolescence will again make it possible to try. Because of the size of the sales, competition is rugged. However, heating is essential and if the price and other factors are right, there is an opportunity through salesmanship and advertising.

O. E. Gammill, Jr., of the Carrier Corp., explained the operation and indicated the field limitations of a new, heat operated, refrigerating machine of the absorption type, using steam as a heating medium. He supplied formulas for computing the owning and operating cost of this and competing types of equipment, and gave the advantages of each. The particular interest of the district heating industry in this equipment is that it will use available offpeak steam in the summer season and not require steam during the winter peaks.

Improvements at Notre Dame

In the absence of the author, Brother Borremeo of the University of Notre Dame, South Bend, Ind., Clifford Strock presented his paper describing the improvements made to the heating system of the university, the installation of controls, and finally the adoption of better operating methods.

There are 50 buildings on the campus heated from a single plant by steam circulating through 2¼ miles of tunnels. The maximum generating capacity of each of the four boilers is 35,000 lb per hr at 130 psi and 410 F. The connected heating load is 314,262 sq ft of equivalent steam radiation.

During the 1948-49 heating season fuel consumption averaged 1.157 tons per degree day. For the last season before the installation of control the comparative figure was 1.621 tons. The saving is thus 28.6 percent.

A study of when to use a shunt flow meter and when to choose a condensate meter was made by Richard H. Brown, Rochester Gas and Electric Corp., a member of the association's meters and accessories committee. Mr. Brown reported that his conclusion was that both types of meter have their proper place.

The theory of the testing by air of one type of meter was first explained by W. G. Gillim, New York Steam Corp., who then enumerated the 11 steps in the test procedure and outlined the calculations involved. The author presented several charts and tables prepared to simplify the work.

District Heating in Europe

Arthur S. Griswold, The Detroit Edison Co., chairman of the NDHA research committee, reported on district heating in Europe where he spent several months last winter on a mission for the ECA. He said that he had not had the time to investigate thoroughly but it appeared that most of the projects are institutional hot water systems controlled by local or national governmental bodies.

He said the big steam systems are in Paris and in Brussels. In the latter city, almost 50 textile works are served steam for process work. This brings the system load factor well over 50 percent.

Mr. Griswold said that in Great Britain, 22 public housing projects are to be heated from central hot water plants.

[This is the second of two articles by Mr. Collins reporting the NDHA meeting. The first appeared in the July HPAC.]

TO MEASURE RADIATION 70 MILES UP

Progress on an instrument which will measure radiation in air more than 70 miles above the earth's surface has been reported by Dr. Severin Raynor, senior scientist at the Armour Research Foundation of Illinois Institute of Technology.

Scientists plan to measure heat radiated from the sun, the earth, and space with a gyro stabilized sphere which will be ejected from a rocket on its way up at a speed of about 1800 mph. The metal sphere will contain three gyroscopes, 14 temperature sensors, and a camera unit for recording the data to be studied later.

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Unit Heaters, Underfloor Tunnels Heat Buildings at Big Stove Plant

PERFECTION STOVE CO., Cleveland, this year will produce gas, electric, and kerosene ranges in one of the world's most modern stove plants—its Ivanhoe Road plant.

The new press building, 855 x 110 ft and 60 ft high, is heated by nine unit heaters having a combined output of 8,550,000 Btu per hr. They are thermostatically controlled from the floor level. Air is drawn from the ceiling, passed through the heating element, and projected through revolving discharge outlets to the working level. The area covered by each unit heater is slowly swept by the heated air discharged by the outlets, which move through an arc of 360 deg. The assembly building, including the tool room area, is a structure of 480 x 420 ft. The first floor has heating outlets located near the center of the building so that the general travel of air is from the center outward. These outlets are served through concrete underground tunnels from a supply unit in an equipment room above the north truck docks. This unit has capacity to furnish 6,300,0000 cfh of outdoor and recirculated air, which is filtered through automatic oil filters and tempered by copper fin heating coils.

Ventilating was a major problem when it came to planning the first floor of the assembly building. Practically windowless on three sides, the first floor has outdoor air supplied through more than 1900 ft of tunnels.

The second floor of the assembly building has 330 by 480 ft heated by 24 unit heaters, with revolving discharge outlets, totaling 8,146,000 Btu per hr. The remainder of the second floor is heated by units, with stationary outlets, with an aggregate capacity of about 4,000,000 Btu.

The boiler plant at Ivanhoe has three 600 hp, two drum, water tube, water wall boilers, each with an underfeed stoker and forced draft fans with duplex electric and steam turbine drives. Draft, feedwater, and stoker speed are all under automatic control. All water fed to the boilers is treated and heated.

All steam, return, and air lines leave the boiler room through a large walk-through underground tunnel leading to the main plant. The basement of the boiler house has a vacuum pump through which all heating returns are pumped to the heater-softener plant. Similarly, two pumps and receivers take the returns from the process steam and the condensate from the high pressure lines.

Coal and ash handling is practically a "dress-up job" at the Ivanhoe plant. The boilers are equipped with a suction type ash conveyor which carries all ashes through cast iron pipes to a large ash silo at the rear of the building. Here, trucks back under a chute to collect the ashes and cart them away. The fuel itself is dumped first in an outside hopper, then automatically conveyed to a 400 ton overhead bunker.

The consulting engineer was George S. Rider Co., and Smith & Oby Co. was the heating contractor.

***Left*—One of 13 octagonal supply grilles through which air warmed by steam heating coils supplies the first floor of the assembly building. Adjustable louvers operated with a key wrench make it possible to vary the amount and direction of air coming through the eight sides. *Right*—This fan supplies air through concrete underground tunnels to the outlets**

Contractors Discuss Pipe Welding Methods

SUCCESSFUL PIPE welding depends upon the development of a proper procedure and the training of the operators to follow this procedure, and several of the talks, committee reports, and an informal round-table session on welding problems at the 60th annual convention of the Heating, Piping & Air Conditioning Contractors National Association stressed these two points and discussed methods for achieving them.

For example, John H. Zink, of Baltimore, at the informal session, pointed out that the contractor must tell the operator the proper procedure—not vice versa. Mr. Zink said the contractor should put a helmet on and watch a good operator work, for his own education. The helmet will "conceal your ignorance," he remarked humorously, "if that is necessary." Richard S. Tobin, Cambridge, chairman of the association's welding committee, told the contractors they "shouldn't let the operators kid them into believing they possess supernatural powers," for the operators aren't magicians waving magic wands.

It is the contractor's duty to provide efficient welding conditions so that the operators can do their best work. In the shop, three factors to consider are light, ventilation, and cleanliness, Mr. Zink pointed out. He mentioned that at his shop, the welding machines are blown out with air every two weeks to get rid of the copper and other dust.

Pressure Welding Machines

Use of pressure welding machines, particularly for radiant heating work, was discussed at some length and with some difference of opinion on the advantages of this method for piping. Wray M. Scott, of Omaha, a user of the method, said that it was important to have the pipe ends very round when using pressure welding. D. H. Corey, Detroit, suggested the advisability of a 7 deg angle rather than square ends so that the inside circumferences of the pipe would come together first.

A member of the group cited difficulty that was being experienced in the welding of radiant heating coils for several bus garages, where about one joint out of every 50 failed completely. It was suggested that perhaps carbon caused the trouble, and that therefore the trouble came at the machine's stopping and starting points.

At the informal session, there was rather extensive discussion of the back bend test, the general feeling seeming to be that it was too severe on welding and that no other joining process has to meet a test of corresponding severity. However, it was felt that this test was so firmly entrenched that it could not be modified, and that welding procedures would have to be used that can meet it. At least, "we should stick to it until we get a better test," Mr. Zink remarked.

The matter of the various codes that govern welding of pressure piping was also discussed informally. Some of them "badly need" revision, it was stated, and it was hoped that conflicting code requirements would be brought into harmony. Mr. Tobin felt the ASME boiler code was perhaps the most up-to-date, and if the contractor doing pipe welding was well-posted on the pertinent sections of this code he'd have a pretty good background of information on welding code requirements in general.

The gist of the entire discussion boiled down to this fact, in the words of Mr. Scott—that good welding can be done only if there is a first-class welding procedure backed up by good supervision, good equipment, and careful, conscientious operators.

In his report as chairman of the committee on welding, Mr. Tobin told of the completion during the past year (in cooperation with the National Certified Pipe Welding Bureau) of the revision of the standard procedure specifications for metallic arc and oxyacetylene welding of wrought iron and steel pipe, fittings, and flanges, and metallic arc welding of carbon molybdenum steel pipe, fittings, and flanges, copies of which had been mailed to all HPACCNA members.

Acceptance of welded piping has now become so general, he said, that it is shown and specified "on nearly every installation."

He recommended that all contractors intending to perform any pipe welding become familiar with the specifications recommended by the HPACCNA, as well as section IX, welding qualifications of the ASME boiler code, also the ASME rules for construction of power boilers, particularly the requirements of the preamble and paragraphs P-23 (J), P-108, P-112, P-116, P-299, P-300, P-301, P-303, P-308, P-311 and P-317 of these rules. These two ASME publications can be obtained from the American Society of Mechanical Engineers, 29 W. 39th St., New York.

Certified Pipe Welding Bureau

Appointment of Robert S. Green, assistant professor and acting chairman of the department of welding engineering at Ohio State University, as consultant to the National Certified Pipe Welding Bureau was announced by William W. Murray, Jr., New York, chairman of the bureau's board of trustees, in his report. Professor Green has visited a number of the bureau's local chapters to discuss their administration and the testing of welding operators, and the plan is for such visits to be continued. He will be available to localities desiring to form chapters of the bureau to see that they are established on a sound basis.

Professor Green then discussed the control of quality in welded piping, and the value of the bureau's work in qualifying operators.

Mr. Zink, chairman of the editorial committee for the Standard Manual on Pipe Welding, reported progress on the new edition, which has been completely written, some sections requiring several rewritings to keep pace with developments. Illustrations for the book are still needed, however.

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Ratings for Package Units

In reporting for the boiler output committee, Chairman George P. Nachman, Cleveland, paid tribute to the great amount of work done by his predecessor, Harry Hart, of Chicago. He mentioned the need for certified ratings of package steam generators, and said the situation with this type of equipment is—from the contractor's viewpoint—somewhat similar to that existing in the heating boiler field a number of years ago. He invited the cooperation of manufacturers of package units in assuring uniform rating tests, reasonable allowances for overload, proper allowance for pick-up, piping, etc.—particularly for the heating boiler applications.

In the home heating committee report, J. A. Ljunggren, Chicago, chairman, stressed particularly the commercial advantages of basing hot water heating system designs on 240 Btu output; "every Btu output lower than 240 builds up sales resistance due to increased material and labor costs, and is the cause of much business being lost by our craft," he said. Thousands of installations designed on 240 Btu output are operating with satisfaction, he stated, and he saw no danger from any safety standpoint. Relief valves of reliable manufacturers, when placed directly on the boiler, should eliminate any danger from high pressure, he remarked. It has been recommended, he said, that safety valves be furnished with hot water boilers, as has been the practice with steam boilers.

Paul A. Edwards, Pittsburgh, chairman of the committee on standards, reported on regulations for providing adequate protection from explosion of hot water heating boilers. He said the committee had voted to recommend that relief valves or safety devices for systems should be furnished by the boiler manufacturer and that all relief devices should be placed on top of the boiler.

Operators for Gas Driven Welders

The report of the committee on apprenticeship was given by its chairman, Arnold H. Goelz, Chicago. He discussed the development of a course of study to be used in conjunction with the Instruction Manual for Steamfitting Apprentices. This had been completed and approved by the HPACCNA but not by the United Association.

In the report of the committee on industrial relations, of which Robert B. Miller, New York, is chairman, problems arising in collective bargaining due to "national agreements" were discussed. Of particular interest to many members in this report was a letter from the general president of the International Union of Operating Engineers on gasoline driven electric generators for welding. According to this letter, the trades involved "shall refrain from demanding" an operator on gasoline engines furnishing power to drive one machine no larger than 300 amp on a project. When two or more machines of this size, or one or more of larger size, are utilized on a project, the operating engineers union "will assert its jurisdiction," according to the letter.

The committee report mentioned that there was only one case pending of interest to it, the dispute between the sheet metal workers and the pipefitters over the handling and erecting of units with duct connections to and from the unit. This had not yet been set for hearing.

Rating Refrigeration Equipment

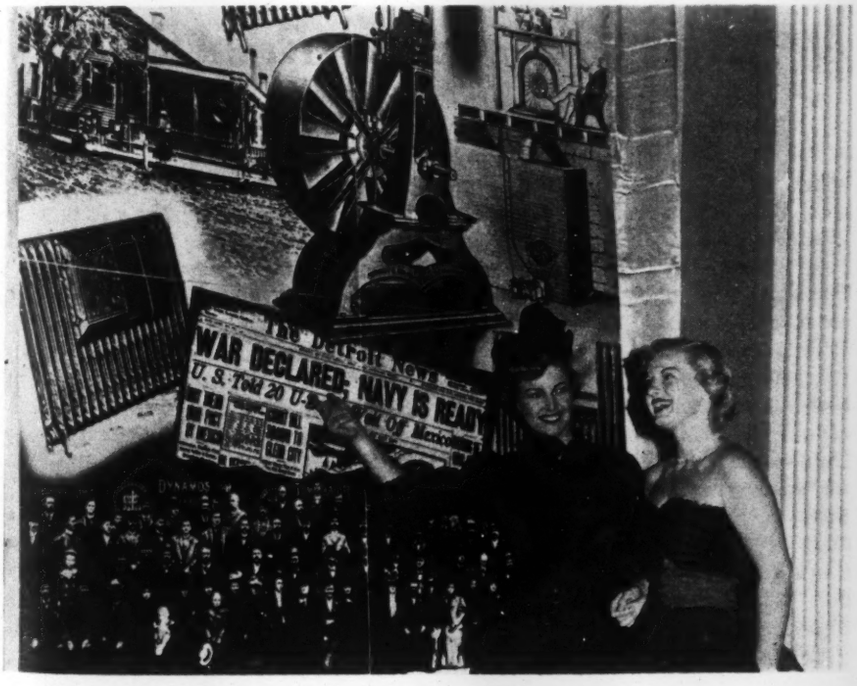
Austin S. Ford, chairman of the refrigeration committee, discussed published ratings of low-side equipment and said that the contractors "must have ratings that can be used in the field arrived at in a manner similar to boiler ratings." Various associations have been contacted on this matter, and have assured the committee they will go along in any program that it proposes.

Rowland Tompkins, the HPACCNA representative on the American Standards Association council, listed the standards of interest to the contractors which had been adopted since his previous report. He said that ASA sectional committee B31 is studying the Code for Pressure Piping, and will probably recommend the issuance of another supplement.

During the convention, awards for distinguished service to the HPACCNA were given to Walter Klie (posthumous), George M. Getschow (posthumous), John H. Zink, and George P. Nachman.

[This completes our story of the HPACCNA convention, the first part of which appeared in the July issue.]

This year's annual convention of the HPACCNA—largest in the association's history—started off with a pageant depicting six decades of development of the industry. Here, two of the appropriately gowned models pose before one of the historical photo murals



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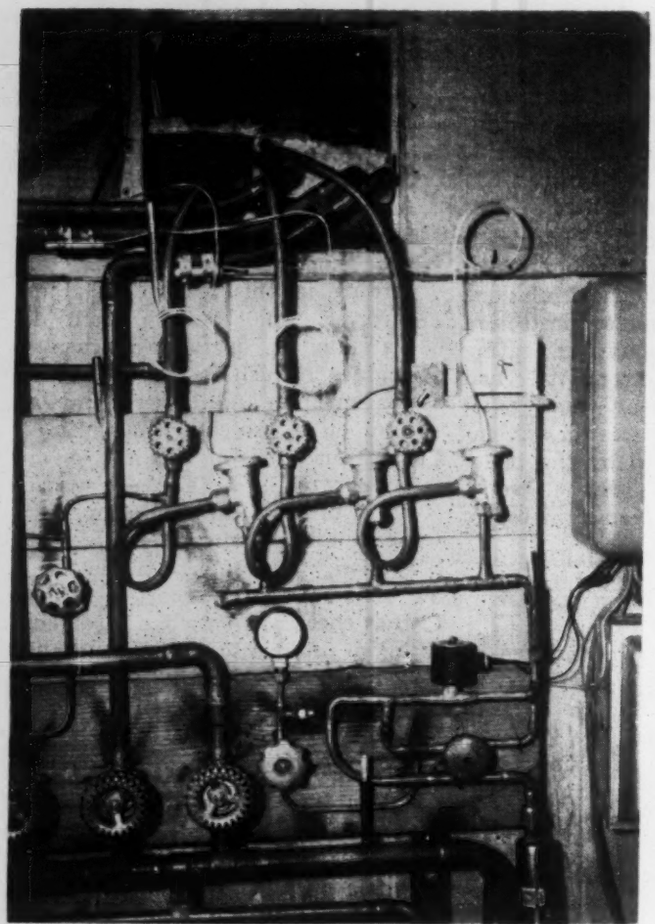

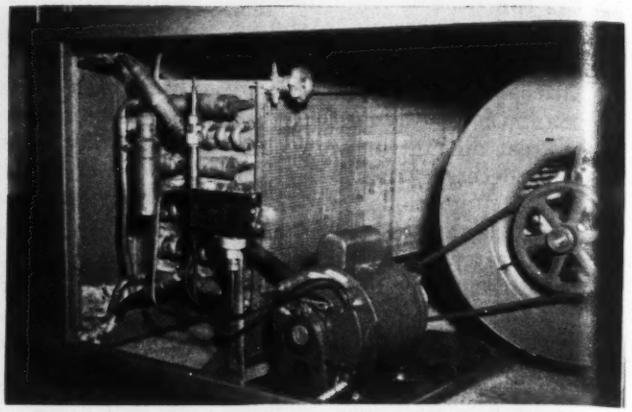

***Left*—Close-up of the expansion valves, solenoid, and filter. The leads to and from the ground coils drop into the ground beyond the concrete wall. *Right*—The air conditioner with the side panel removed. The summer expansion valve had not been installed when this picture was taken**

G. D. WETHERBEE, refrigerating engineer, Chicago, has obtained considerable operating and performance data on an actual installation of a heat pump job, the basic design of which was conceived and calculated by him. As a result, he feels certain that this method of heating will become accepted for regions with a normal heating season of around 6300 degree days. He presents some of the data here, together with information and comments on details

HEATING WITH THE HEAT PUMP

Equipment Details, Operating Results

LAST DECEMBER, a heat pump installation was put in service at Mt. Prospect, Ill., which is about 20 miles northwest of Chicago. The heating system consists of a 5 hp compressing unit, a conventional duct system for air distribution, and a combination of earth-buried and atmospheric coils as a heat source. The results have been so far beyond expectations that it seems certain to the author that, within a period of years, the heat pump will become accepted as a method of heating buildings in regions with a normal heating season of 6300 degree days.

A considerable amount of operating data has been obtained on this installation, and some of it was presented in an article in the July HPAC. Further details of the installation and its operation are given this month.

This heat pump installation is the sole source of heat for the one story, six room building, which is occupied by Mr. and Mrs. Roy E. Hammond, except for a fireplace for decorative purposes and a 1500 watt bathroom heater. The plan area is 1433 sq ft outside of the foundation. The ceiling height is 8 ft. There is a full basement 7 ft high.

Refrigerant Pressures and Temperatures—Because of the throttling action of the expansion valves, very uniform operating pressures and temperatures have existed. These are given in an accompanying table, which shows the approximate maximum and minimum values after the transient period at the start of a cycle.

Refrigerating Capacity—The capacities given in the manufacturer's performance ratings are based upon 65 F suction gas entering the compressor and no subcooling. Actual performance was with 48½ F gas entering the compressor and 76½ F liquid entering the expansion valves.

Refrigerant pressures and temperatures (approximate maximums and minimums)

Air entering air conditioner.	68½- 72½ deg
Air leaving air conditioner..	98 -163 deg
Compressor discharge pressure	163 psig*
Entering expansion valves..	159 psig*
Out of expansion valves....	25 -26 psig
Suction pressure at compressor	20½-22 psig
Compressor discharge temperature	164-168 deg
Leaving condenser	111-116 deg
Leaving subcooler	84-87 deg
Entering expansion valves..	74-79 deg
Out of expansion valves....	24-26 deg
Into heat exchanger (from earth)	38-40 deg
Suction line near compressor	47-50 deg

*These values were transient during each cycle; about 140 psi a minute after a start to about 170 psi when compressor stopped. A record of several cycles taken at 1 min intervals showed an average of 163 psi with a high side pressure drop of about 5 psig.

The cooling effect of 1 lb of "Freon 12" as rated by the manufacturer is about 87 — 38.5 = 48.5 Btu per lb circulated. Actual performance was about 84 — 27 = 57 Btu per lb. Therefore, the actual refrigerating capacity is about 57/48.5 = 117½ percent of the rated capacity. The values quoted are not highly accurate because they were taken from a Mollier diagram instead of from a table; however, they are well within the accuracy of our observations.

Subcooling—There was some subcooling within the condenser resulting from liquid entrapment. The subcooling coil in the return air stream was very worthwhile. The effect of the heat exchanger was much less than anticipated considering that its rated capacity is 5 tons. Heating the suction gas to 65 F instead of 48½ F would further increase the refrigerating capacity some 6 percent and a more effective heat exchanger is to be installed before next winter.

Coefficient of Performance

Typical average discharge pressure during an operating cycle was about 163 psig. Suction pressure averaged about 21 psig. Compressor speed was 820 rpm. The manufacturer's rating at these conditions is 34,300 Btu per hr refrigerating capacity, and, corrected for actual operating conditions, the actual capacity is 57/48.5 × 34,300 = 40,400 Btu per hr.

The average watts input to the motor is about 4700, which is equivalent to 16,050 Btu per hr. Therefore, the compressing unit coefficient of performance is (40,400 + 16,050) /16,050 = 3.51.

The input to the blower motor is 350 watts, and the solenoid and holding coil are assumed to require 50 watts; these are equivalent to 1350 Btu per hr. Therefore, the overall coefficient of performance is (40,400 + 16,050 + 1350) / (16,050 + 1350) = 3.32.

Compressing Unit Details

The compressor was selected because of its long stroke, as it was believed that it would have a greater efficiency than a short stroke design at high discharge pressures and with a ratio of compression which might exceed 6 to 1. A single phase motor was selected for local utility rate reasons.

The motor, compressor, and dual pressure control are mounted on a steel base. This unit rests on cork pads 2 in. thick on the concrete floor of the basement.

The two cylinder compressor has a 2½ in. bore and a 3½ in. stroke. The displacement is 34.3 cu in. per revolution and the speed is 820 rpm. The displacement is 16.3 cfm. The manufacturer's condensed performance rating is:

Head pressure,	Suction temperature			
psig	15 F	20 F	24 F	28 F
150	31,900	35,600	38,900	42,400
160	31,000	34,700	37,700	41,200
170	30,200	33,700	36,800	—
180	29,300	32,800	—	—

The ratings are based on 65 F suction gas temperature and no liquid subcooling.

The 5 hp, single phase, 230 volt, 60 cycle motor has a speed of 1750 rpm. The efficiency at full load is 79 percent and at three-fourths load is 76 per cent. Power factor at full load is 90 percent and at three-fourths load is 80 percent. The maximum safe loading is 5400 watts. The motor load was about 4600 watts near the start of an operating cycle and increased to about 4800 watts near the end of a cycle.

The pressure control which came with the compressing unit is used merely for limiting purposes. It opens the holding coil circuit of the starter when the head pressure reaches 190 psig or when the suction pressure reaches 10 psig.

A standard 3 ton oil separator is installed in the discharge line; it was considered a necessity for a system containing so much refrigerant flowing through large tubes with a multitude of traps. The recommended amount of oil was added with the refrigerant and the oil level has remained constant in the crankcase ever since without adding any more oil.

The Air Conditioner

The air conditioner is of the horizontal air flow type of a standard make, except that the heat exchange coil is special. Outside dimensions of the enclosure are length 44 in., width 43 in., and height 26 in. The nominal air circulation is 1500 cfm.

The motor is ½ hp, single phase, 115 volts, 60 cycles, 1750 rpm. The blower is of 13 in. diameter and is 10 in. long.

The finned coil is 29½ in. wide, 9 in. deep, and 15 in. high, and has 225 9 in. by 15 in. fins in 29½ in. The tubes are ⅝ in. OD, six deep and 10 high. Primary surface is 24.1 sq ft, finned surface is 363.5 sq ft, and total surface is 387.6 sq ft.

Of the six rows of tubes, the first is used to subcool the liquid from the receiver. The other five are headered top and bottom to form a five pass condenser. Thus, only five-sixths of the surface is condenser surface.

Blower Control

The blower motor in the air conditioner is started and stopped by a back acting, high pressure control connected to the liquid line. It starts the blower when the head pressure reaches 140 psig and stops

Summary of operation, January-May 1949, inclusive

Volume of structure, cu ft	14,000
Degree days	3,678
Condensing unit kwhr	5024
Fan kwhr	372
Pump kwhr	186
Total kwhr	5,582
Hours operation	1,064
Watts (4700 + 350 + 400)	5,450
Heat of refrigeration @ 40,400 Btu per hr	43,000,000 Btu
Electrical heat (three motors)	19,000,000 Btu
Hours operation per degree day	0.289
Kwhr per degree day	1.52
Kwhr for 6300 degree days	9,550
Kwhr per degree day per 1000 cu ft	0.108
Same incl. 1/5 of basement volume	0.095
COP (cond. unit only)	3.52
COP (three motors)	3.26
Load factor, percent	28.3

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it at about 135 psig. The idea is to avoid blowing unheated air into the building at the start of a cycle and to salvage the heat in the condenser at the end of a cycle.

Present Condenser Not Large Enough

The air cooled condenser in the air conditioner has been adequate for the operating conditions as they have existed. With 69 to 71 F return air from the building, the air leaving the condenser has been 99 to 102 F when the air circulated is in the neighborhood of 1500 cfm.

However, it was found during a test that with a suction pressure of around 25 psig, the head pressure goes up and the high pressure limiting control, set at 190 lb, stops the machine. Therefore, the condenser is not large enough to take advantage of high suction pressures.

A sensible-heat-removing section is being constructed and will be placed on the downstream air side of the present condenser. It will consist of two passes of identical size and construction as the present six passes. The discharge gas will then flow in series through: (1) a two pass section to remove approximately the sensible heat; (2) a five pass section to condense the vapor; (3) the receiver; (4) and a one pass section to subcool the liquid. Of course, the air will be counterflow to this sequence.

The receiver, of steel construction, is 6⅝ in. in diameter and 60 in. long. Its nominal capacity is 60 lb of "Freon 12." It is equipped with a refrigerant level gage glass. The refrigerant charge is 125 lb of "Freon 12," of which about 25 lb is in the receiver and 10 lb is estimated lost during testing, etc.

A large silica gel dehydrator is installed at the receiver outlet where 114 F liquid refrigerant flows through it. (It should have been placed after the heat exchanger, with 76 F refrigerant, to increase its moisture absorbing capacity, but then it would not have been included in the summer cycle. No moisture trouble has been experienced, however.) There is a strainer in the liquid line just ahead of the expansion valves.

The performance of the liquid-to-suction heat exchanger was disappointing. It raises the temperature of the suction gas from an average of 39 F to an average of 48 F with an average of 76 F liquid leaving the exchanger. Before next winter, a heat exchanger with at least twice the capacity will be installed.

There was no solenoid valve in the liquid line when the system was placed in operation. At the end of a cycle, all the refrigerant would drain out of the receiver into the earth coils and at the start of a cycle, liquid would flood back to the compressor. Operation has been improved since a solenoid valve was installed. It is connected to open and close in direct response to the room air thermostat when the compressor starts and stops.

Expansion Valves Replaced

The three original thermal expansion valves were of nominal 1 ton capacity designed to limit the suction pressure to 25 lb. They seemed to operate as fixed orifices because the bulb had no control. They were replaced with three 1½ ton valves with a 30 lb limiting feature. The operation was noticeably improved but the bulb still had no control.

None of these valves had equalizer connections. Three 3½ ton valves with equalizer connections were tried but had to be removed immediately because of extreme "hunting" which would drain the receiver, partly pump down the low side, and flood back to the compressor all within a few minutes. Three 2½ ton valves without equalizer connections are now installed and are giving complete satisfaction.

This constant suction pressure type of operation before the last valves were installed was fine for purposes of heat balance and capacity analysis of the building and refrigerating equipment. However, it has made it impossible to come to any conclusion regarding the earth coil system except that it was more than adequate last season.

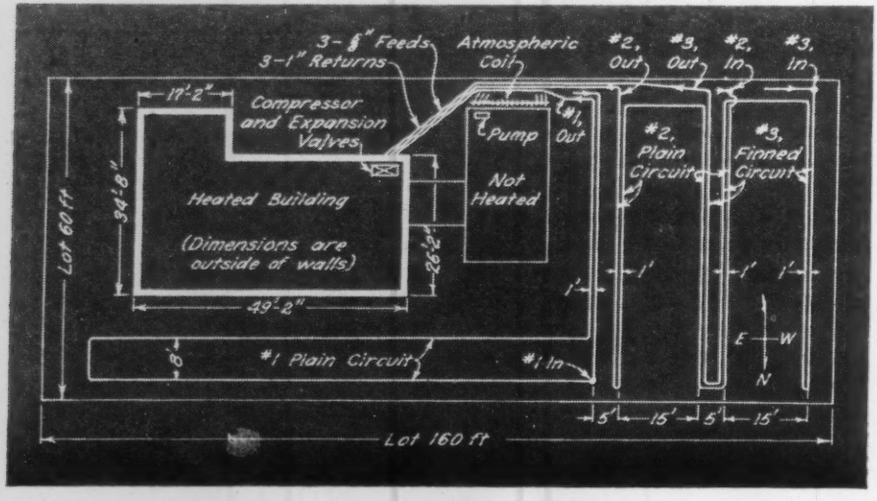
The trouble probably lay in the fact that there are long lengths of ⅝ in. OD tubing extending from the expansion valve outlets to the 1 in. OD earth coil inlets, causing a pressure drop of from 4½ to 5½ lb.

For test and observation purposes, the three earth evaporators were separated all the way from and to the panel board. This required a lot of excess tubing. For the same reason, three expansion valves were used. Likewise, there are a large number of shutoff valves which would not be needed in an installation if all the design factors had been well known.

As it exists, the piping and valving is complicated and overlapping because it is an experimental installation. It could be greatly simplified.

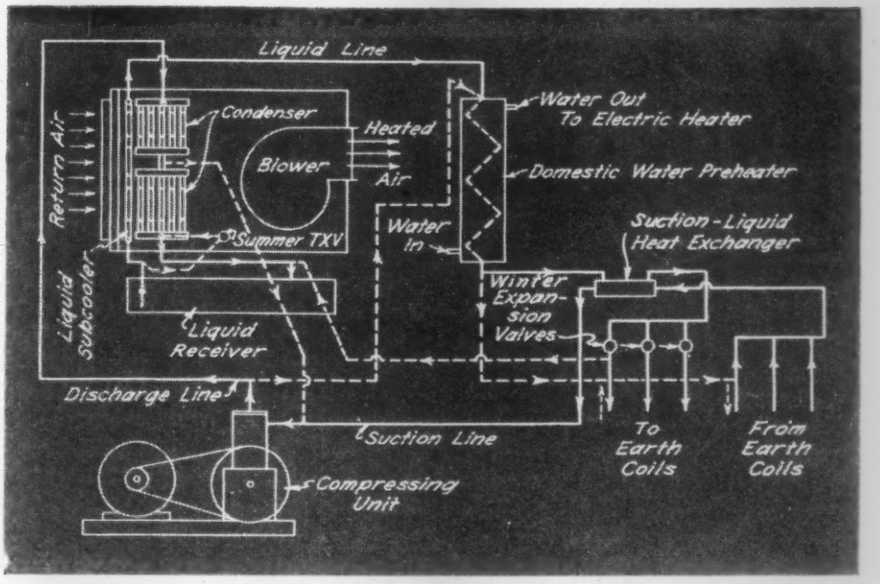
Room Air Thermostat Controls Compressor

The compressor motor is started and stopped in response to an ordinary double throw, air condition-



Arrangement of building and coils. Tubing is 5½ to 6 ft deep. All trenches were 16 to 18 in wide and 54 to 60 in. deep before topsoil was replaced. The tubing is 12 in. (plus or minus) apart in the No. 2 and No. 3 circuits. The ⅝ in. tubing feeds from the expansion valves to points marked (•) and "in." Only the "Freon 12" tubing is shown here. Secondary system tubing parallels "Freon 12" tubing from and to atmospheric coil

Schematic piping layout, the summer cycle being shown by broken lines. Shutoff valves are not shown



ing thermostat which actuates the holding coil of the starter for the 5 hp motor directly, as well as the solenoid valve. Its range being from 70 F to 90 F, it is impossible to set it as low as might be desired for night operation.

Evaporator Circuits

The evaporator is made up of copper tubing buried in the earth 5½ to 6 ft below the surface. The tubing is 1 in. OD, 0.049 in. wall thickness, dead soft, 115 ft lengths, the long lengths being used to minimize the number of buried joints.

Circuit #1: One tube per trench, 8 ft center to center.

Circuit #2: Two tubes per trench, 12 in. center to center.

Circuit #3: Two tubes per trench, 12 in. center to center, finned.

There is a length of ⅝ in. OD tubing from each expansion valve to the inlet of each circuit.

Circuit #1: 303 ft of 1 in. and 107 ft of ⅝ in.

Circuit #2: 292 ft of 1 in. and 77 ft of ⅝ in.

Circuit #3: 303 ft of 1 in. and 92 ft of ⅝ in. 250 ft of the 303 ft is finned.

Total, 898 ft of 1 in. and 276 ft of ⅝ in. Of this, 128 ft of each size tubing is overlapping to separate the three circuits for test purposes. Hence, the fully effective lengths are 770 ft of 1 in. and 148 ft of ⅝ in.

There is also a secondary system for absorbing atmospheric heat when conditions are advantageous.

More details regarding the earth coil system, both primary and secondary, and data concerning the operation will be published later.

Domestic Water Preheater

With the idea of salvaging every possible Btu, a tank was ordered to preheat domestic water ahead of the primary electric water heater. So-called "tempering tanks" are frequently used for this purpose in Chicago where the city water sometimes goes as low as 34 F, and are considered to be worthwhile.

The preheater is an ordinary 12¾ in. OD by 60 in. high cylindrical tank with a ¾ in. OD helical copper coil in it. It was to have been placed in the liquid line after the air stream subcooler. With 80 to 85 F refrigerant entering, it was believed that heat could be usefully transferred to the cold water. It would also serve a useful summer function.

Unfortuately, a leak was detected during installation and the tank had to be returned for repair. The result is that it was not re-installed until after the heating season had ended and no data concerning its operation have been obtained.

No Noise Problem

In planning the installation, a great deal of thought was given to the possibility of noise. It was believed that a 5 hp compressing unit in a ceilingless basement in a quiet neighborhood would present a serious noise problem, particularly at night. Plans were made to apply acoustical material to the ceiling and walls, enclose the unit in a soundproof house, etc.

None of these things has been done because no need has arisen. The unit rests on four 6 in. squares of 2 in. thick heat insulation type corkboard. There is a vibration eliminator in the suction line but none in the hot gas discharge line through which most of the vibration would travel to the heating coil (condenser). The discharge line is solidly fastened to the concrete basement wall, which seems to prevent vibration transmission to the air conditioner.

The operation of the unit can be heard upstairs but one has to listen for it. The sound is of comparable magnitude to an oil burner, according to several observers. The typical sounds of a forced air circulating system predominate over those from the compressor and 5 hp motor.

Standing beside the unit, the noise is no different from any machine of its type and size.

Heat Losses From Equipment

No direct means of heating the basement is provided and it was uncomfortably cold last winter, temperatures of 50 to 55 F being observed near the floor and 55 to 60 F near the ceiling. Some consideration was given to insulating the hot discharge line and receiver to reduce the heat losses but this seemed foolish when more heat is desired in the basement and when some provision for direct heat is being considered. Therefore, none of these theoretical losses is a real loss, including the heat from the motor.

[Mr. Wetherbee's next article will be devoted to heat balance calculations, and will compare theoretical heat losses and heat gains based upon recorded operation of the equipment.]

* * * * * *

The Equipment Developments and Recent Trade Literature columns published each month in HPAC are intended to keep you posted on new and improved products. Be sure to read these departments regularly.

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Three New
INDUSTRIAL RESEARCH CENTERS

Postwar industrial building programs have included numerous research laboratories and research "centers." Piping, air conditioning, and heating services are of prime importance in structures devoted to research and product development, and the following paragraphs present some "notes" on these facilities in three of the big research center developments.

FIRST UNIT of the Ford Motor Co.'s large, new research and engineering center under construction at Dearborn, Mich., is a huge dynamometer building where engines will undergo tests determining power, gas consumption, etc. It is the first of several buildings that are planned for a 500 acre tract west of the famous Dearborn inn. The buildings will be spaced about an artificial lake 800 ft long and 350 ft wide. They will be of modern design, featuring steel and concrete construction with brick facing and stone trim.

Upon establishing the site for the first unit, steam lines and waste lines were run into the area. Three lines (a 10 in. main steam distribution line, a 6 in. pump discharge line, and a 2 in. drip or trap discharge line) run through the steam conduit.

A concrete cradle 4½ ft in width with 21 in. sides was poured. The bottom of the cradle is 8 in. and the side walls 9 in. in thickness. An internal drain 3 in. deep runs down the center of the cradle, and a 2 in. chase runs along the inside edges of the cradle walls.

After laying the steam lines into the cradle, sections of 36 in. vitrified clay half-round or channel pipe were laid over the cradle, resting on the rabbets. Pipe joints and rabbetted joints were sealed with cement. Approximately a 7 ft earth cover was placed over the line.

This method of industrial steam line insulation is said to have a number of advantages, including simplicity of installation, as the clay channel pipe can be laid as work progresses on steam line installation. Ease of accessibility for possible future needs is also a feature; should a break occur in the steam lines, or should it be necessary to tap into them, it is easy to remove one or more sections of the channel pipe and get into the line. The arch type construction is strong and cuts to a minimum excess space in the conduit which, in turn, lowers heat loss. The entire 1600 ft of steam line was protected in this manner.

The dynamometer building will house 32 soundproofed dynamometer cells, each of 200 hp capacity; there may be two additional cells of 500 hp capacity each, both with separate control rooms. To take care of room exhaust discharges, masonry ducts approximately 10 ft square and engine exhausts in 2 ft steel pipe were constructed.

Voorhees, Walker, Foley and Smith, New York City, is the architect and engineer.

For the steam lines at the Ford research and engineering center, a concrete cradle was first poured, with sections of 36 in. vitrified half-round or channel pipe installed over the cradle to complete the conduit

PIPING, AIR CONDITIONING FOR CHEMICAL RESEARCH

ONE OF THE "most versatile and up-to-date chemical research centers in the world" is being put into operation by Carbide and Carbon Chemicals Corp., according to Dr. G. O. Curme, Jr., vice president. It is located on a 140 acre tract near the company's South Charleston, West Va., plant.

As typical examples of the many unique features, ingenious supports in each laboratory permit complete versatility in the location of laboratory equipment, and each laboratory can draw on any one of the 14 separate utilities from permanent outlets—including such unusual services as cold brine, oxygen, hydrogen, nitrogen, and steam at either 15 or 200 lb per sq in.

The laboratory building proper is designed as a three story, T shaped structure of steel and brick, 325 ft long by 96 ft deep. It contains 69 individual laboratories and 48 offices, a large scale laboratory, a library, an auditorium seating 125, and necessary storage and service.

All laboratories range along one wall of the building, which simplifies, with maximum economy, all service piping and exhaust duct installations. A special structural system is used for pipe supports in the service runouts. With wall inserts in each laboratory, and, in effect, an adult version of the familiar children's "Erector" sets having an ingenious system of channel members and clips, provision is made for a completely flexible method of supporting piping, shelving, and laboratory equipment.

Laboratory services play an important part in the construction of the building, for every effort has been made to dispense with unsightly temporary fixtures. There are actually 14 separate and distinct utilities available to each laboratory desk. In addition to the usual services, such as hot and cold water, distilled water, cold brine, fuel gas, compressed air, and vacuum lines, all the laboratories are supplied with nitrogen, steam at 15 lb per sq in., and outlets for 110 volt a-c with a built-in variable voltage control for controlled heating. Provision has also been made, wherever needed, for installing 200 lb steam, oxygen, and hydrogen, as well as 220 volt a-c. Outlets for connections to laboratory apparatus are located at the rear of each bench to permit removal of the furniture without disturbing the service lines.

All service supply lines extend through vertical shafts from main headers in the basement at each bay, and connections are made at each floor to permit horizontal runouts. From the horizontal lines, branches to the service strips at the rear and above the laboratory benches, to hoods, to distillation areas, and to sinks run either along the partition walls or in recesses in the floor. Covered floor recesses and other enclosures are all easily accessible. In addition, access doors to the vertical shafts are located in the corridors to permit shutting off utilities in individual laboratories in case of emergency.

All the laboratories and offices of the buildings are air conditioned, with air supplied at a maximum of 80 F and 50 percent relative humidity in the summer and at a minimum of 70 F and 25 percent in the winter. These conditions are maintained by a 600 ton refrigeration unit. Incoming air is cleaned by electrostatic precipitators. Each room has a thermostat for individual temperature control. In addition, one laboratory room is equipped with a special unit to provide constant temperature and humidity conditions.

Elaborate precautions have been taken to prevent contamination of office areas, and cross-contamination between laboratories. This is accomplished by providing each laboratory with an individual exhaust fan of sufficient capacity to remove the conditioned air supplied to the room plus that supplied to the office areas. Thus, each laboratory is under a slight negative pressure with reference to the offices and corridors.

Most of the laboratories are equipped with fume hoods. Since the operation of a fume hood requires much more air than can be economically supplied from the conditioning system, each hood has an independent supply of clean, tempered air. When a hood is placed in operation, the air supply duct is opened and the exhaust fan speed is doubled. Both of these operations are accomplished by throwing a single lever.

Vertical duct systems for air conditioning and fume hood exhausts are all located in the center of the building adjacent to columns. In this fashion, ductwork is held to a minimum and is hidden.

Employee safety has received careful consideration. As mentioned, for example, the air conditioning system is designed to prevent contamination of the building with toxic or flammable vapors, and in addition, the basement and pipe shafts are continuously purged by exhaust fans located in the penthouse.

Air view sketch of Carbide and Carbon Chemical Corp.'s new research center. Back of the main building is the shop and power house, and the cooling towers that serve the high pressure laboratories are in the back corner

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BIG RESEARCH CENTER PART OF $60 MILLION PROGRAM

Construction of the group of buildings comprising the Johns-Manville research center was started in 1945 as one of the projects in a company-wide $60 million postwar program of expansion, cost reduction, replacement, and improvement. It is under the supervision of the company's general engineering department. Shreve, Lamb & Harmon, New York, is the architect, and Syska & Hennessy, New York, the mechanical engineer.

The site is an 88 acre plot on the north side of the Raritan River about ¾ mile from the main manufacturing plant of the company at Manville, N. J.

The laboratory section of the product development building has been laid out with the basic laboratory module 11 ft wide by 26 ft long. This 11 ft width dictated the column spacing of 22 ft in the laboratory section and 44 ft in the manufacturing section.

The type of partition used is built with a steel stud and faced with integrally colored asbestos-cement board on both sides. The stud webbing has been made to permit the passing and fastening of all laboratory piping so that it may be concealed within the wall. Built in 4 ft wide sections, it is readily movable.

All laboratories are fitted with separate hot and cold water, gas, compressed air, vacuum, steam and waste water lines, and electric service. About 30 laboratories are provided with fume hoods of asbestos-cement board for the exhaust of obnoxious gases. The entire laboratory section of the product development building is air conditioned.

The main building of the group that composes the research center is the research and administration building.

With laboratories and administrative units devoted largely to pure research and primary experimental work, this building is the heart of the research center. All spaces are completely air conditioned. In addition three groups of laboratories have separate systems of special air conditioning. There is an auditorium, a library, dispensary, cafeteria, dining rooms, and kitchen facilities.

Laboratories and working space in this building include a materials testing laboratory with a 60,000 lb machine and a 300,000 lb machine. There are acoustic laboratories with "live" and "quiet" rooms and a reverberation chamber. There is a sample preparation room, a high humidity chamber and a fog room, a long path optics laboratory, insulation testing laboratories, including a furnace room and a conductivity laboratory with special "cold" rooms. A large physics laboratory has been constructed with separate spaces for special problems in physics. There is space for apparatus repair and construction, high voltage electrical tests and control, special heat flow problems, and particle size and surface area study.

Air conditioning equipment is located in the basement and a large penthouse contains various fan systems and two cooling tower units. The compressor room, transformer and switchboard rooms, steam room, and kitchen are all in the basement.

A construction feature is hung metal acoustical ceilings. They are made of light metal perforated pans, 12 by 12 in. square, that slip simply into the metal framework. They can be quickly removed and replaced, thus giving free access to the piping, wiring, and ducts that they conceal. A dual purpose is thus achieved as the perforated pans are backed by sound absorbing pads which create an effective acoustical ceiling. These ceilings are so designed that troffers have been substituted for individual pans to provide the new laboratories with recessed fluorescent lighting.

Research technicians have easy access to the various services they require. Water, steam, compressed air, vacuum, and electricity are piped to convenient locations in each of the laboratories. The piping for each service is concealed between the asbestos-cement board partitions behind quickly removable access plates.

Operation of the research center and the company's 20 plants in the United States and Canada has required a mechanical building devoted to the building of equipment and machines required for research, development, and plant operation. This building is adjacent to the product development building. It is heated with blower type unit heaters.

Just west of the mechanical building, and connected by a passageway, is the engineering building which houses the company's general plant engineering department and the engineering offices of the research department's mechanical section. The brick exterior walls are damp-proofed and all exterior walls are lined with rock wool insulation and a vapor seal. The duct system arranged to carry conditioned air in summer is also utilized for the transmission of warm air for the heating season.

Operation of the research center requires process water with a supply equivalent to the demand normally expected from a town of 10,000 people. To meet this requirement, a filtration plant was built about 170 ft north of the Raritan River, with a penstock at the river and an intake of two 24 in. pipes.

The filtration plant building is a brick and steel and concrete structure 70 ft, 9 in. long by 44 ft, 8 in. wide. It has two stories above the ground level approach. Below this level a reinforced concrete one story clearwell was constructed with a storage capacity of 190,000 gal. Of this capacity 110,000 gal is available for fire and general service and 80,000 gal is reserved for fire use only. The first floor of the filtration plant is arranged with pumps and operating equipment and filter beds while the second floor provides a chemical feed and storage room and facilities for operating personnel.

Two deep well pumps of 2000 gpm lift the raw water from the screening pit and pump pit to the accelator which is a cylindrical reinforced concrete tank 34 ft, 8 in. in diameter and 25 ft high. In the accelator the water is treated with alum and soda ash. After a retention period of 45 min it is satisfactorily clear for the filter beds. There are two filter beds with provisions for a third. Each bed has a normal filtration rate of 500 gpm with availability to handle 150 percent of the rating if necessary. The water flows by gravity from the accelator to the filter beds. The entire system is tied in by means of an operating device which automatically controls the chemical treatment, pumps, chlorine dosage, predetermined rate of flow, etc.

The new Johns-Manville research center consists of four main structures: the research and administration building, the product development building, the general engineering building, and the mechanical building

The filtration plant is equipped with a night service pump with 150 gpm capacity, one medium service pump of 325 gpm capacity for light plant demand, two large service pumps of 750 gpm capacity each, which accommodates the present complete rating of the filter beds. In addition there is a fire pump of 1000 gpm capacity at a pressure of 100 lb per sq in. This complements the protective capacity of a 75,000 gal sprinkler protection tank built in the form of a watersphere. Positive pump operation is achieved by an automatic vacuum system which operates through an arrangement of solenoid valves and mercury switches to provide 20 in. of vacuum on pump suction lines for 45 sec before pump operation begins.

Process water is returned underground to a waste water treatment plant situated 50 ft northeast of the filtration plant. This water treatment plant is a reinforced concrete substructure with a sedimentation tank base 12 ft below ground. The waste water reaches it from the plants through a 12 in. asbestos-cement pipe into a screening and small chemical chamber before introduction to the flocculating basin which is 36 ft long and 10 ft, 6 in. wide. At this point the waste water is agitated by paddles and given its primary sewage treatment. From this basin the waste water is turned into one of the two sedimentation basins, which are each 66 ft long by 17 ft, 8 in. wide. There the sludge is precipitated and the residue liquid remains in detention for at least 2 hr while chemical treatment is provided to make the discharge suitable for introduction into the Raritan River. The precipitated sludge is pumped from the sludge bed back to the filter plant where a vacuum filter extracts liquids and leaves only a cake of dried sludge which is collected and trucked away to a refuse dump. Because of these processes, the water is actually returned to the river in purer condition than it was when originally taken out.

The fire protection system for the research center includes sprinklers and hose stations within each building, the 75,000 gal sprinkler protection storage tank or watersphere, and a supply of Raritan River water from the filtration plant distributed by an underground piping system to outside hydrants.

The watersphere consists of a 28 ft diameter sphere mounted on a 101 ft, 6 in. slightly tapered riser column which is 7 ft, 4 in. in diameter at the base. This riser column is carried in turn by a truncated conical base which flares to a 28 ft, 6 in. diameter at the supporting concrete ring foundation. For access and inspection, the sphere is provided with ladder rungs up the outside of the riser column to the bottom of the sphere. An exterior spiral stairway then goes up to a platform at the equator of the sphere. From this platform to the top of the sphere is a quadrant length ladder which is arranged to revolve from the pole of the sphere.

Erection procedure of the watersphere placed the truncated conical base and completed the tapered riser column, and a flared neck, up to the bottom of the sphere. The steel sphere was constructed on a platform supported by and around the conical base about 15 ft above the ground. Three small derricks were then erected inside the riser at the top, 120 deg apart, and lifting cables were dropped through temporary cut outs in the top of the sphere to pickup points at the bottom of the sphere. The derricks, after hoisting the sphere up the riser column to its final position, were removed and lowered through the riser and passed through the access door at the base.

Steam requirements of the research center for process work and heating required the bringing of high pressure steam from the boiler house at the company's main plant just across the Raritan River. An 8 in. steam line with a 3 in. return is carried on steel poles 24 ft on center, 9 ft above ground, across the Raritan River bridge for ½ mile, and then below ground in 24 in. tile arch conduit for another 1000 ft to the product development building. Steam is further distributed to the other buildings.

The sanitary sewer system required to service this large research operation required the placing of 2070 linear feet of asbestos-cement sewer pipe to a sewage lift station which was constructed on the north bank of the Raritan River. From this point, 620 ft of steel pipe was laid under the river and asbestos-cement pressure pipe carries the sewage ½ mile to a tie point in the Manville sewer system. Steel pipe was laid under the river by sandbag cofferdamming the north half of the river and excavating the shale river bottom after breaking it with jack hammers. The pipe was then laid and encased in concrete and the cofferdamming operation was repeated on the south side.

In addition to the sanitary system, underground systems have been constructed covering the entire research center site for storm water, waste water, fire lines, and service water. These systems required asbestos-cement pipe, Class 1, in amounts of 9850 linear feet of 5 in. to 24 in. size for storm water, and 2570 linear feet of 6 in. to 12 in. size for waste water. They also required asbestos-cement pressure pipe, Class 150, in amounts of 5125 linear feet, sizes 3 to 10 in., for the fire lines, and 2100 linear feet of 4 to 10 in. pipe for the service water. These underground systems required more than four miles of trench excavation and the removal of 35,000 cu yd of each in depths of 4 to 15 ft.

Modern Thinking Applied to

DUCT DESIGN

A CONVERGING duct (reduction in area) presents a situation where losses can be very low. The value for f' can go as low as 0.02 if the reduction in area is rounded, as it is for a nozzle or bell mouth entrance.

There are two general classes of reductions. One, where a vena contracta is caused by the use of a sharp edge, has a very high coefficient f'. In the other, the vena contracta is eliminated by use of a rounded or gradual entrance. The loss for the latter is low.

Another fact is that flow into a converging entrance tends to distribute its velocity uniformly across the opening. This is why an exhaust grille tends to have a better velocity distribution and may be connected as in Fig. 11A.

Taking q in the smaller opening or entrance, we have roughly (for the *R.N.* in which ductwork is designed) the following values for f'.

OBSTRUCTION	f'
Inward projecting pipe.....	0.80 to 1.00
Sharp corner entrance, duct leaving plenum	0.50
Slightly rounded entrance.....	0.25
Bell mouth entrance, a nozzle entrance, radius greater than $\frac{1}{2}$ entrance diameter	0.04
Sloping round or rectangular reduction in duct area, included angle 30 deg or less.....	same as straight pipe

For the value of q to use with the values for f' given above, it should be taken in the entrance, the smaller area, the nozzle throat, the duct leaving the plenum, etc.

Reductions Made at Elbows—If the data on ells are followed, virtually nothing need be added to the f' for a standard ell to allow for reduction in area. Reductions at ells are convenient and good practice. It is to be noted that this is very different from enlargements; no matter where enlargements occur, a substantial loss can result.

Exhaust Inlet Distribution—An entrance to an exhaust system is a reduction in area. As stated above, under these conditions flow is very uniform. Fig. 11A indicates the wide latitude permissible in connecting exhaust inlets. Good distribution across an exhaust grille is easy to attain.

Obstruction Definitions

In order to define the differences between various restrictions that come under the head of "reductions in area," Fig. 11B is presented. The orifice is sharp upstream and made so the vena contracta does not re-form in the orifice opening. The nozzle is rounded to prevent the formation of any vena contracta whatever. The pipe entrances shown are characterized by being arranged so that a vena contracta is formed and then reformed in the pipe opening.

In the case of an orifice, the test of a sharp edge upstream is generally the non-appearance of a line of light around the edge. The vena contracta formation seems to require a sharp edge plus an abrupt stoppage of flow around the outside of the opening.

The f' values given on Fig. 11B are very rough. Again these should be plotted from test data of f' vs. *R.N.* They would then be reliable and easy to use under any conditions.

Orifice Data

One of the uses to which *R.N.* plotting has been applied generally for some time is for orifice data. Fig. 11C shows f' vs. *R.N.* data plotted for six different pieces of apparatus or proportions. These are six setups, each a different diameter ratio (the ratio of orifice diameter to pipe diameter).

A slight difference when the data are taken using 2 in. or 12 in. pipe will be noted. For practical purposes this can be ignored.

The *R.N.* is figured in the orifice, using the diameter in feet and the feet per minute through it just as if the quick method for a duct the same as the orifice diameter were being used.

Fig. 11C shows the friction or loss for an orifice in a pipe. This loss is

KIRBY WALKER draws upon his experience both in the heating and ventilating field and in wartime research and engineering to discuss duct design. A licensed professional engineer, he was engaged on heat transfer and combustion projects for two large aircraft companies during the war. He has had a wide experience in the heating and ventilating industry, and has supervised manufacturers' laboratory and development personnel. This is the fourth of a series. In the March issue, straight ducts were discussed, and in April some amplifications and corrections appeared. In May, the subject of elbows was covered, and in July, plotting and predicting pressures was discussed. This month, convergence, reduction in area is the subject. Future issues will take up enlargements; tees and duct branches; duct sizing methods and comments; a summary of points brought out in the series; symbols and formulas; and references and source material, with the author's comments on their contents

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Top—**Fig. 11A—Exhaust inlet distribution.** *Center*—**Fig. 11B—Illustrating definitions of various restrictions that come under the head of "reductions in area."** *Bottom*—**Fig. 11C—Orifice loss data**

pretty close to a static pressure difference read on "pipe taps." That is where the data came from and for which the information may be used. Pipe taps are static taps placed $2\frac{1}{2}D$ upstream and $8D$ downstream of the orifice. These taps are used for measuring flow.

A better way to measure flow is by means of the nozzle. If the pressures through a given nozzle are plotted, it is readily seen what the static difference is. With the loss only 0.05 q or less, no charts or data are needed if ± 5 percent is accurate enough for the purpose.

Open End Static

There is a very helpful fact or condition which for want of a better term may be called "open end static." It occurs when a fluid is leaving an opening and entering a larger space. It exists only when the exit flow is straight out of the opening with the flow lines all parallel just as in the case of a pipe end or nozzle throat discharging into a larger space. Under such conditions open end static exists; that is, the static pressure in the larger space is the same as that just inside the outlet.

This may seem too obvious to be useful, but if it is kept in mind it simplifies many pressure analyses and is a necessity in plotting pressure gradients.

SYMBOLS

D = (equivalent diameter) = (feet) = $\frac{1}{3}\frac{\text{(sectional area, square inches)}}{\text{(perimeter, inches)}}$

d/D = (diameter ratio) = (orifice diameter) / (pipe diameter)

f' = (friction coefficient, shock losses) = h/q

fpm = (actual average feet per minute velocity)

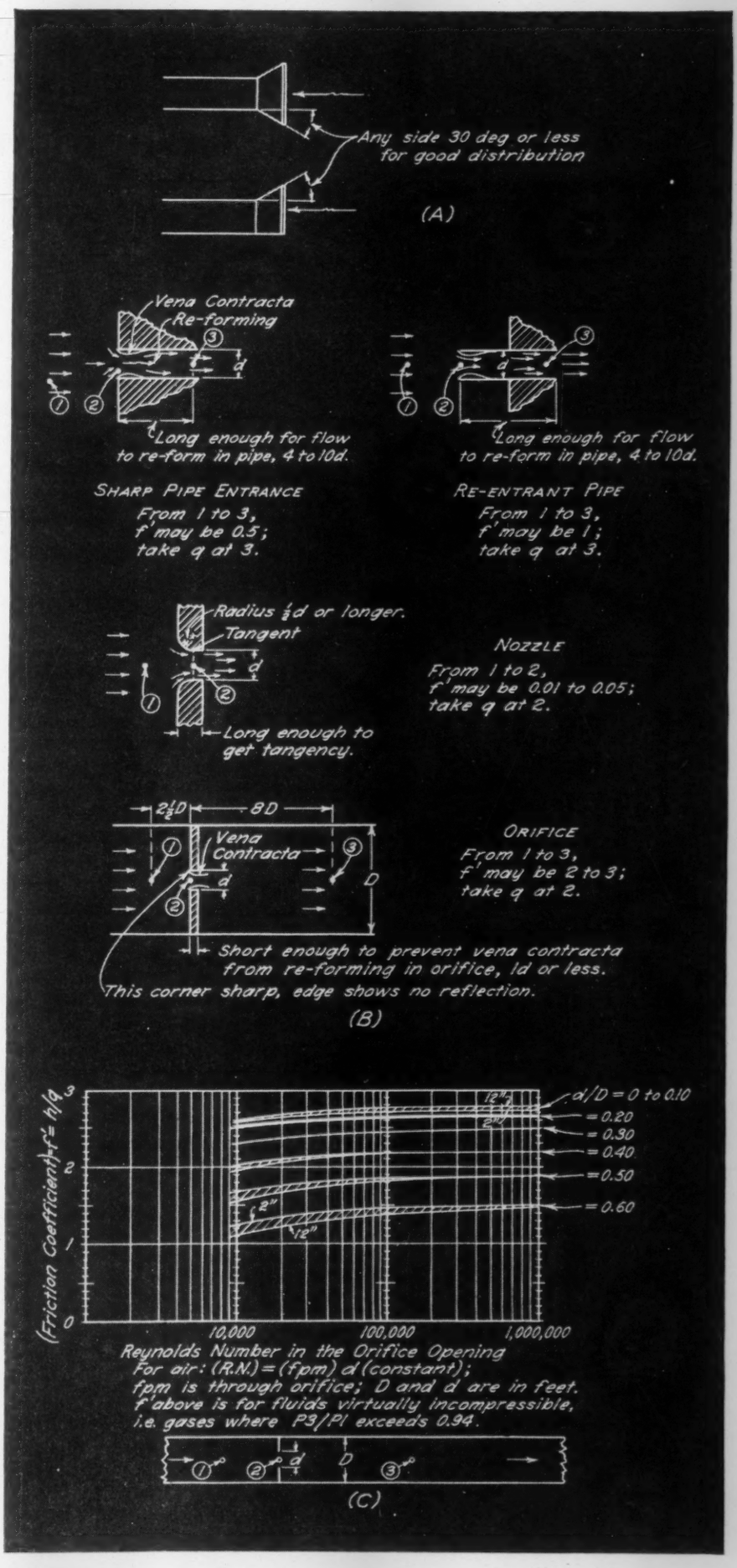
h = (loss of total pressure) = (inches 32 F water column)

$h = q f'$; shock losses, obstructions

P = (absolute static pressure) = (lb) / (sq ft)

q = (one velocity head of the average velocity) = (inches, 32 F water column)

R.N. = Reynolds number


Any side 30 deg or less for good distribution
(A)
Vena Contracta Re-forming
Long enough for flow to re-form in pipe, 4 to 10d.
SHARP PIPE ENTRANCE
From 1 to 3, f' may be 0.5; take q at 3.
RE-ENTRANT PIPE
From 1 to 3, f' may be 1; take q at 3.
Radius ¼d or longer.
Tangent
Long enough to get tangency.
NOZZLE
From 1 to 2, f' may be 0.01 to 0.05; take q at 2.
2½D
8D
Vena Contracta
ORIFICE
From 1 to 3, f' may be 2 to 3; take q at 2.
Short enough to prevent vena contracta from re-forming in orifice, ld or less.
This corner sharp, edge shows no reflection.
(B)
(Friction Coefficient f' = h/q)
d/D = 0 to 0.10
= 0.20
= 0.30
= 0.40
= 0.50
= 0.60
10,000
100,000
1,000,000
Reynolds Number in the Orifice Opening
For air: (R.N.) = (fpm) d (constant);
fpm is through orifice; D and d are in feet.
f' above is for fluids virtually incompressible,
i.e. gases where P3/P1 exceeds 0.94.
(C)

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QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Write the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

One Inadequate Stack Will Do a Better Job Than Two

A reader's problem on correcting insufficient draft for an oil burner installation is answered this month. Instead of the right size stack, there are two smaller flues and the 25 gph burner can only be fired at about 8 gph. It is pointed out in replying to this question that one inadequate stack will do a better job than two of them. How the required fan capacity for mechanical draft can be calculated is explained

WE WOULD appreciate [writes "D.J.G.," a heating contractor] information on how to correct insufficient draft on an oil burner installation. The boiler calls for a 20 in. stack, he says, and we have two 12 in. flues, each with a 16 in. smoke pipe from the boiler to the flue. Thus, there are two separate chimneys side by side. The oil burner is capable of firing 25 gph, but due to lack of draft it can only be fired at about 8 gph. We would like to correct the condition without changing the chimney, and are thinking of using forced draft with blowers, he concludes.

KALMAN STEINER, of C. Hoffberger Co., Baltimore, a member of HPAC's board of consulting and contributing editors, has prepared the following reply to "D.J.G.'s" question:

One Inadequate Stack Better Than Two

"Strangely, one inadequate stack will do a better job than two. It might be supposed that, since the areas of the two stacks add up to 226 sq in., as against the required area of 314 sq in., the combined stacks would come within 28 percent of the theoretical, which surely should permit burning more than one-third of the required fuel. Actually, the separate stack areas are not additive and, quite the contrary, one must subtract from the other.

"It is quite improbable that both stacks would develop precisely the same draft. The slightest deviation in a dimension, in a contour of a brick, in a slope of a wall, etc., would sufficiently affect the draft of one so that it would be slightly at variance with the other. The moment that occurred, with both stacks serving the same boiler, the stack with the higher draft would pull gases not only through the boiler but through the other stack as well. In other words, the stack of lower draft would act just as a draft controller does on the breeching, allowing air to shortcircuit into the system and diminishing the pull of the other stack on the firebox.

"It would be much better to determine by means of a draft gage which of the two stacks develops the higher draft, and to use that one only, shutting off the other with a tight damper, or disconnecting it entirely from the system. This simple step might immediately increase the available draft sufficiency to permit burning substantially more than one-third of the design capacity of fuel.

"But to develop the boiler to its

rated output, provision must be made for more draft. Two alternatives are possible—erecting a chimney of the required size, or installing a fan for mechanical draft. If the latter is to be resorted to, then, for this case, induced draft will be much simpler of attainment than forced draft.

"An induced draft fan must be designed to handle hot gases. The usual design temperature is 600 F. Bearings must be air cooled. The mounting should provide a bypass around the fan with a tight fitting damper, to be used should there be a breakdown of the mechanical system—electrically or mechanically.

Figuring the Fan Capacity

"The required fan capacity can be calculated readily. At room temperature, allowing for excess air over theoretical for perfect combustion, a gallon of fuel oil takes about 2000 cu ft free air. The stated 25 gph design capacity then calls for 50,000 cfh, or 833 cfm at 70 F. At 600 F the volume of a gas is about double its room-temperature volume, meaning that our fan will need a capacity of about 1700 cfm.

"A quick check is had from the rule of thumb: Allow 11 cfm per boiler hp at 70 F and 22 cfm at 600 F. Since 25 gph of fuel oil about equals 75 boiler hp, the answer by this method would be 22 × 75 = 1650 cfm.

"Since the calculated fan capacity provides about 25 percent excess air, the duct between boiler and fan suction inlet should have a barometric draft regulator, or equivalent, to maintain high combustion efficiency."

RADIANT HEATING SERVES GREENHOUSES

Radiant heating in greenhouses is a new development that may have far-reaching effects on the cultivation of flowers, plants and some vegetables.

Through radiant heating installed in the concrete floor of a greenhouse, or in the soil itself, a uniformly warm root system may be maintained while the air is kept at the temperature required for healthy growth.

Radiant heating is seen as a means of combating mildew and disease and of increasing the vigor and stamina of plants.

One of the few such systems in operation in the country is that recently installed in the "dream greenhouse" of Donald A. Dickerson, at Bloomingdale, Mich.

Mr. Dickerson's building is 62 ft by 312 ft and he has placed 1¼ in. wrought iron heating pipe on 12 in. centers in four zones. The floor construction consists of crushed stone to a depth of 8 in. in which the pipes are buried near the top. Over the stone and pipe is a 2 in. concrete slab.

Ideal for Crops From Bulbs

After his first winter of operation, Mr. Dickerson reports that results have convinced him that radiant heating cannot be excelled for growing plants. He said that it is ideal for growing crops from bulbs such as lilies, hyacinths, jonquils, and others of this type.

At Semmes, Ala., Owen Blackwell, owner of the Blackwell nurseries, has installed a radiant heating system in his azalea beds, which contain more than a million plants. The heating pipe has been laid directly in the ground.

The nurseries have 35 azalea beds to a section, each bed being 48 ft long and 6 ft wide. The boiler is situated in the geometric center of the plot, with a 2 in. hot water supply line running around the perimeter of the plot.

This line is in a dirt trench about 10 in. underground. Each individual bed has a run of 1¼ in. pipe attached to a plank forming the perimeter of the bed. The center line of flow of water is about 6 in. above ground. Hotbed sashes are placed over the wooden planks. The temperature is kept at a minimum of 40 F.

Pipe lines extend the length of the Blackwell nurseries, Semmes, Ala., where a radiant heating system has been installed in the ground of the azalea beds that contain more than a million plants. Heat from the hot water circulated through the system warms the earth and stimulates the growth of the plants

Reader Asks for Suggestions on Re-Using Water from Coils

You are invited to answer the following question from a reader of HPAC. Suitable comment on the matter will be welcomed, and—space permitting—will be published and paid for at regular rates. Sketches and photos are particularly desired. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

Here's the question:

"Water furnished by a deep well pump supplies 75 gpm to a set of coils for air conditioning a factory area. The plant engineer wants to use the water after it leaves the coils. However, the factory demand for water fluctuates anywhere from 10 to 50 gpm. Using the present setup, what is the best way to obtain constant pressure for plant use, constant pressure for the air conditioning coils, and adequate excess water disposal?"

—G.M.

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SAM LEWIS' PAGE

Informal comment on heating, piping, and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, member HPAC's board of consulting and contributing editors

What's the Best Practice on These Two Jobs? Readers Ask

. . . . . and Mr. Lewis devotes his page this month to answering them. One reader inquires about connecting a steel firebox boiler and a cast iron sectional boiler, the water line of the former being 18⅝ in. above that of the latter. The second reader seeks advice on the proper method of installing overhead copper coils for radiant heating

LET'S DEVOTE the "Page" this month to some comments prepared in answer to two of its readers. One concerns a boiler installation, and the other is about radiant heating coils.

Connecting Steel and Cast Iron Boilers

A friend in Alaska writes that he has been asked to connect a steel firebox boiler to a sectional cast iron boiler, both operating on steam at low pressure. He reports that the water line in the steel boiler is 18⅝ in. higher than the water line of the cast iron boiler.

It is desired (he says) to make this team operate together or independently, without resetting the cast iron boiler base 18⅝ in. higher than the base of the steel boiler or without pitting the steel boiler so as to have its water level the same as the water level of the cast iron boiler.

It has not been determined whether a boiler return trap or a condensate pump will be used.

It is obvious that this ill-matched team will *not* operate together as steam boilers unless they have the same water line, and even then I would not be too happy about their cooperation.

It is possible to return the condensate to a receiving tank several feet above the highest boiler water level and to return the condensate from this receiver to a separate tilting trap for each boiler. These traps may be noisy and will almost certainly cost more than the cost to raise the whole cast iron boiler 18⅝ in. The traps will, of course, represent a maintenance problem.

Install a Pump?

It is possible to install an electric pump (provided electric energy is dependable and available). This pump could accept condensate from the receiving tank and could feed it to either or both boilers through a separate water line governor having an electric switch and a water feed valve connected to each boiler and equalized above and below the water line. If the water level in either boiler falls, a float opens the balanced feed valve and the pump forces the water into the boiler until the rising float closes the valve.

The pump might be of the centrifugal type and could operate continuously at no great objection. A pressure relief valve in the pump discharge pipe, however, might open after both boilers have enough

water, bypassing the water from the pump back into the receiver. A float switch in the receiver might stop the pump if the condensate in the receiver should approach overflowing, and the simple electric switch, part of the water line governor, would start the pump if either boiler required water.

This equipment again would cost more than enough foundation to elevate the cast iron boiler or to dig an 18⅝ in. excavation for the steel boiler.

The best answer would be to trade either one of the boilers for an exact mate of the one retained. If my experience over a lifetime is worth anything, this trade will be the ultimate answer, since no plowman ever did do a first-class job with a mule and a cow hitched together.

Installing Overhead Radiant Heating

A foreign reader propounds a question concerning radiant hot water heating by overhead copper coils, as follows:

"We are accustomed in this country to install panel heating installations with copper tubes where the copper tubes are in the ceilings and particularly in the lower part of the concrete slabs. The general proceeding in the erection of this type of installation is that after the forms for the slabs have been finished, the reinforcement steel bars are laid and immediately on top of the bars we are installing copper tube coils for which, generally, ½ or ¾ in. diameter is used. We have never had any trouble at all with this sort of installation. Now, one of our competitors—who has secured the contract for a new office building for an industrial concern—has received instructions not to lay the pipes inside of the concrete, but to have them suspended underneath the slab and covered with plaster only.

"Is there any new experience in your country on this problem which might have induced the owner of the new building to give this new instruction?"

I am in some doubt whether the man who asks this question has adequate authority for the technique that he states is customary in his area.

The usual arrangement, in my experience with ceiling radiant heating, is to install below the concrete slab a layer of insulation faced with a reflective surface. Then a thin air space is provided, as by expanded metal lath. The copper radiant coils are wired to the lath and then plaster is applied. The purpose of all this is to reduce as much as possible the flow of heat upward from the radiant coils, and to secure the greatest practicable contact between the copper tubing and the plaster, which after all becomes the ultimate heat transmitting surface.

In buildings having several stories with any type of radiant heating, there must be some heat transmission upward from overhead coils and downward from coils imbedded in concrete floors. If copper coils are placed above the reinforcing steel in the roof slab of an upper story, apparently they will be about 2 in. above the bottom of the concrete; say 1 in. for the concrete below the reinforcing, and an inch for the reinforcing and its interlacing, so that the center of the copper tubes would be 2 to 2½ in. into the concrete. The concrete above the tubes might be only 4 in. or so in thickness and the heat from the warm tubes must flow upward as well as downward.

We have designed plants for some industrial buildings with radiant heating coils thus surrounded by concrete, but have always allowed for the heat delivery through the floor of the story above the coils and have increased the heat transmitting surface accordingly so that there shall be no deficiency in the down-going heat.

For the top story, we have provided exceedingly thick and effective insulation above the concrete slab below the waterproof roofing, since there is no virtue in paying to melt the snow on the roof.

If I were the owner of the industrial plant cited, based on the incomplete information disclosed in this inquiry, I would insist that for the ceiling of the top story of this building, there must be an assuredly proved barrier against wasteful and hard-to-control upward heat flow.

Fuel Burned But One Air Pollution Source

"All air pollution does not originate with the burning of fuel as such," H. B. Lammers, chairman of the Coal Producers Committee for Smoke Abatement, told the city council of Lansing, Mich., when he presented the report of a survey on the problem in that city.

"Entirely too much results from the burning of waste, refuse (and garbage) in fuel burning furnaces or in incinerators which are inefficient.

"It is a well established fact that in the average industrialized city almost as much weight of trash and refuse is burned in a year as the fuels that are consumed. The inefficient method of consuming these waste materials is the cause of much of the city's air pollution."

Mr. Lammers told the councilmen that while abatement of pollution in our cities was an engineering problem, the Coal Producers Committee for Smoke Abatement has always maintained that it also was a psychological one as well. "You can be as free of pollution as you are willing to put forth the necessary energy and money to abate it," he said.

Mr. Lammers remarked that recently he found a paper written in 1923 by Osborn Monnett for the Bureau of Mines which shows that this phase of the problem was recognized at that time when he said, "The attitude of the public seems to be more important than the technical question involved. Committees get just as much law enforcement as they desire. Until the public is thoroughly roused, demands smoke abatement, and shows continued interest in it, no permanent improvement is possible. Smoke abatement is not a matter that can be settled overnight and then left to take care of itself without attention but is something that must be watched year in and year out if high standards are to be maintained."

DATA SHEET

Price Discount Computation Chart

TRADE DISCOUNTS from list prices are often quoted on many articles commonly purchased by industrial plants and contractors, and the purchaser, engineer, estimator, or accountant has many occasions to reduce a chain of discounts to a multiplier by which he can determine the actual net price.

On pipe fittings, for instance, quotations, orders, and invoices may show a price, each, of $80.00 list, less 25 percent, less 20 percent, less 10 percent; or $5.00 each, list, less 62½ percent, less 25 percent, less 5 percent. Regardless of the list price fluctuations, the discounts are apt to change even more, so that an infinitely variable series of calculations or tables must be used.

It occurred to the author that a series of curves might be drawn that would allow compact, and perhaps universal, solution of multipliers for any given series of discounts. The accompanying chart has resulted and is in use for computation of commitment values of purchase orders placed, and for close approximation of current unit prices for estimating use. The accounting and purchasing departments are also furnished with copies of the chart for their use as needed. Note that dollar values may be computed directly; also, by the chart, as shown in the alternate of example No. 2.

In the examples given here, the multiplication is fairly simple, but in actual practice one might have list prices and discounts that are not easily figured; in fact, any combination is possible, whereas the chart covers all arrangements with fair accuracy. Of course, if large quantities or dollars are involved, the chart would serve best only as a rough check or quick estimation.

One user at our plant has devised a hinged straight-edge which is pivoted at the lower right hand corner at zero abscissa and 100 ordinate, and by means of which any diagonal may be accurately traced to the vertical line desired. An accompanying, loose, horizontal straight-edge quickly carries the intersected value to the left-hand scale for re-entry into another diagonal, to which the pivoted edge is swung to meet another vertical line, etc.

No doubt other short-cuts or scale markings will appear to an ingenious, practiced user. For instance, logarithmic paper may be used to secure better subdivisions. Perhaps two complete sets of left-hand scales can be drawn, one above the other, which will allow going into the left-hand edge with a PLUS discount. (Now, the author manually figures these exceptional cases until a net discount of less than 100 is obtained, which is used to enter the chart.) Frequently-encountered series of discounts may be marked on the left column for immediate reference.

One minor objection to the chart as now used is its size (about 11 in. x 22 in.). It has not been tried on smaller paper with more accurately and more finely ruled lines, but possibilities exist there also. In general, however, the chart as shown has slide-rule accuracy and has been accepted as very much worthwhile when one is confronted with a group of prices with trade discounts of varying nature.

In further explanation of the use of the chart, we have at our plant a control system which originates in the engineering department with an approved, numbered "Work Order." A "Bill of Material," carrying this number, is prepared from installation drawings for each job. Listed thereon are quantities and sizes of each type of pipe, fittings, valves, hanger and flange bolts, insulation, and other material that is needed for the work authorized. Purchase requisitions are written against these bills, with like items such as steel pipe, cast iron, aluminum, or other material generally grouped on one requisition, to aid in securing quotations from suppliers in those particular fields.

The requisitions are checked against the purchase orders, when issued, and the *net unit* prices are entered opposite each item on the bill of material, after computation from the discount chart shown herewith. The total value of each purchase order for the job is also shown on the B. M. in order to obtain the amount of material commitments for orders placed to date, and to review the relations of the financial and physical status of all outstanding work.

Base discounts and discretionary discounts are thus resolved into net prices for permanent records and for current estimates and future comparisons and quotations.

Example No. 1

Item costs $80.00 each less 25 percent, less 20 percent, less 10 percent.

By computation: $80.00 × 0.75 equals $60.00; $60.00 × 0.80 equals $48.00; $48.00 × 0.90 equals $43.20, the answer.

By chart: Percent of list after first discount equals 75 percent. Enter chart on left at 75 and follow diagonal line downward to right to second discount (20, read at top). Read back to left scale at 60 and follow diagonal line to third discount or 10 line. Read back to left for net multiplier, or 0.54. Then $80.00 × 0.54 equals $43.20, the answer.

Example No. 2

Item costs $5.00 each less 62½ percent, less 25 percent, less 5 percent.

By computation: $5.00 × 0.375 equals $1.875; $1.875 × 0.75 equals $1.406; $1.406 × 0.95 equals $1.336.

By chart: Enter on left at 0.375 and follow diagonal downward to right to 25 line. Read back to left scale and follow diagonal to third discount or 5 line. Read back to left for final net multiplier or 0.267. Then $5.00 × 0.267 equals $1.335, the answer.

Or, solving the same example by the chart in a different way, enter with dollar value at 50 (multiple of 5) on left. Follow diagonal to first discount on top scale or 62½. Read back to left scale and follow diagonal to second discount line or 25. Read back to left and follow diagonal to third discount line or 5. Read back to left for answer, $1.33.

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By PHILIP H. KLINE
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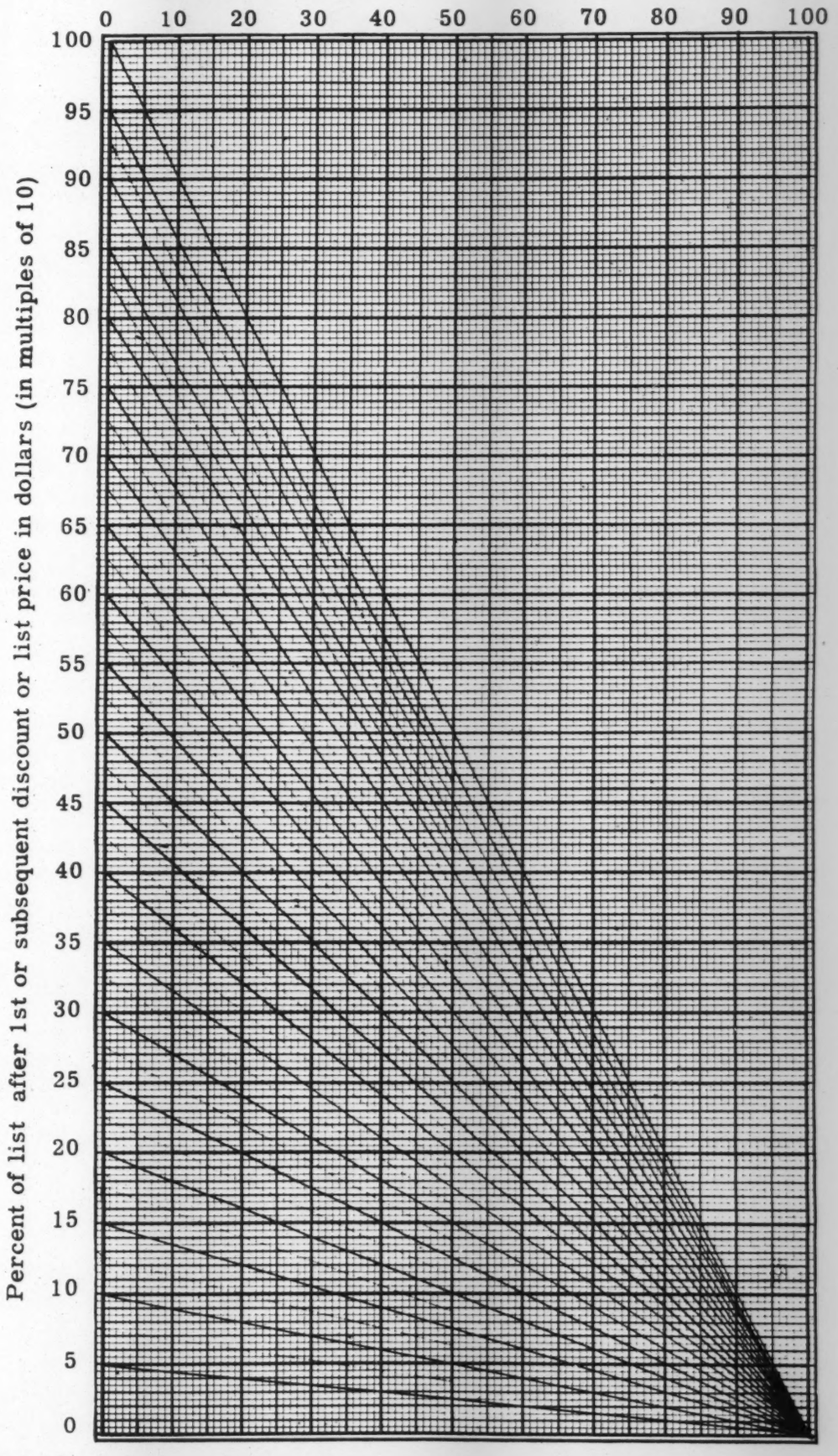
If 1st discount used at left:-These are 2nd and subsequent discounts. If dollars are used at left:-These are 1st and subsequent discounts.
0 10 20 30 40 50 60 70 80 90 100
100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0
Percent of list after 1st or subsequent discount or list price in dollars (in multiples of 10)

Examples showing the use of this price discount computation chart are given in the text

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Flange Rating Standard Is Brought Up-To-Date

In response to an urgent need for a revised edition of the steel pipe flange and flanged fittings standard (B16e-1939), the American Standards Association sectional committee B16 has concentrated on the most needed sections and has issued supplement No. 1 to B16e-1939. This supplement will serve until the committee can complete a revision of the whole standard.

When steel flanges were first standardized many years ago, the theory of flange design was not as thoroughly understood as it is today. Those working on these early standards fully realized their shortcomings and established flanges of very conservative design. During the intervening years, exhaustive investigations have been made on the design of flanges. With this additional knowledge at its disposal, the committee appointed a special task group in 1941 to restudy the design of the B16e flanges.

This task group had been functioning for only a short time when the United States became involved in World War II. Faced with the imperative need for conserving strategic materials, it appeared that much steel could be saved if flanged steel piping materials could be used on a less conservative basis than established by the old standards. The task group was constituted as an ASA war committee and proceeding under the rules established for developing American war standards completed the American war standard pressure-temperature ratings for steel pipe flanges, flanged fittings and valves, B16e5-1943.

In making its study, the task group realized that to change the dimensions of the flanges would result in untold confusion, sacrifice the benefits of interchangeability, and force the expenditure of large sums for jigs, fixtures, and other tooling creating further consumption of steel and thus defeat the very purpose the changes were expected to accomplish. The committee therefore made no dimensional changes in the standard whatsoever, but analyzed the flange stresses in the light of the latest engineering data available and established new higher service ratings for the flanges. Thus, in many cases, lighter weight flanges could be used than would have been necessary under the old, more conservative ratings.

In establishing these new ratings, the task group first made probing calculations by choosing several flanges of each pressure class and found that the 900 lb flanges were the least conservative in their design. They then calculated each flange of this series and from these calculations established safe usable ratings in accordance with the best engineering practice. The other pressure classes were then made proportional to the 900 lb flanges. It was fully realized that because the 900 lb flanges were the least conservative, the other series could have even higher ratings in proportion to the degree of conservatism embodied in the design of each class. The additional amount of steel which could be saved however, would be negligible in comparison to the drawbacks of such a basis of ratings.

With cessation of hostilities, the order making use of the war standard ratings mandatory was withdrawn, leaving the war standard without official status from a practical standpoint. Immediately, confusion reigned. Codifying authorities had not changed their documents to recognize the war ratings and some were reluctant to do so. They believed that not enough experience had been gained in the use of the war ratings and also that the ratings had been established under the stress of war emergency and not by the usual sectional committee.

Those who had made installations at the new ratings were confident that they were sound and did not want to return to the old, more conservative ratings. They stressed the fact that several thousand dollars could be saved in many cases by designing a plant with the new rated materials and that such plants which had been erected were operating satisfactorily.

8000 Calculations Made

Sectional committee B16 was under great pressure to take action that would correct this situation. A special task group under the chairmanship of N. O. Smith-Petersen, who had served as chairman of the war committee also, was formed to restudy the whole matter of ratings. At the same time the MSS ferrous flange committee approached the problem from an entirely new angle by relating the flange stresses to the physical property curves of carbon and carbon molybdenum steels through the entire temperature range. Nearly 8000 individual flange calculations were made by members of the committee. The results of this approach gave ratings almost the same as the war ratings and this information was turned over to the task force. The task force's studies also substantiated the new ratings and reports were made to the main sectional committee. After due deliberation, the committee decided that as the task force's ratings were so close to the war ratings a third set would only complicate matters further.

As a result, supplement No. 1 was approved which concurrently cancelled the war standard B16e5-1943 and revised the rating tables of the peacetime standard B16e-1939.

In addition to revising the rating tables of B16e-1939, supplement No. 1 also brings the material sections up-to-date and also establishes shell thicknesses for welding end valves. The committee has already started the task of revising the whole standard B16e-1939 and supplement No. 1 will be incorporated in the completely revised standard.

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Thermodynamic Criteria for Heat Pump Performance

By John F. Sandfort*, Ames, Ia.

SUMMARY—The heat pump is treated here as a steady flow apparatus, and the maximum conceivable coefficient of performance is computed using the concept of availability, irrespective of any particular cycle. A convenient method is thus provided for analyzing the various ideal gas and vapor compression cycles and determining the degree to which they approach the maximum conceivable coefficient of performance (CP). Emphasis is given to the limitation of the popular single stage vapor compression cycle, and the ideal Carnot cycle.

THE development of the heat pump as an apparatus for heating buildings comes as a resurgence of an idea first introduced by Lord Kelvin in 1852. His proposed design[1] was a two cylinder *thermodynamic engine,* operating on an open air cycle, capable of both heating and cooling small buildings. For various reasons this engine was never built and the heat pump idea lay dormant for nearly 80 years.

During this period the refrigeration industry grew steadily and the early air cycles were gradually abandoned in favor of the more practical vapor compression cycles. When interest again began to develop in the heat pump, it was a natural step to adapt existing refrigeration equipment for this new application. This probably explains why, with rare exceptions, commercial heat pump development to date has concentrated on the single stage vapor compression cycle as the basis of design. However, some air cycle heat pump equipment has been developed in Switzerland and others have been proposed in this country[2]. Some United States aircraft are now air conditioned with air cycle equipment.

Of utmost importance in the design of any heat engine, heat pump, or refrigeration equipment is the establishment of standards against which the performance of any actual or ideal engine or cycle can be compared.

In heat engine design, the desired effect is a conversion of heat to work. This conversion, expressed as a percent, is the overall thermal efficiency of the heat engine. Thermodynamics teaches that the maximum conceivable thermal efficiency of any heat engine operation between two fixed temperature levels is equal to that of the classical Carnot engine.

In the case of heat pumps and refrigeration equipment, however, the concern is with a flow of energy from a low to a high temperature level rather than a conversion of energy from one form to another. Common experience, as expressed in the Second Law of Thermodynamics, reveals that this process cannot occur spontaneously, and therefore additional energy (usually, but not necessarily, work) is required to make the heat pump function.

With refrigeration equipment the desired effect is the transfer of heat from a low temperature area, while with a heat pump the desired effect is the transfer of heat to a high temperature area. For such equipment thermal efficiency has no meaning, and so the expression co-

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[1] Exponent numerals refer to Bibliography.

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efficient of performance has become the accepted method of indicating excellence of performance. Coefficient of performance, abbreviated (CP), can be defined as the ratio of the effect desired over the work required to produce that effect.

In the case of the heat pump this ratio must obviously always be greater than unity if any particular system or cycle is to have any value as a heating machine. But the question is: How large theoretically can this coefficient of performance be for any assigned condition of operation? This question is of particular importance in heat pump design since the heat pump is competitive with the various combustion heating systems.

From thermodynamics it is seen that if the Carnot engine is reversed the result is a heat pump in which the work input is an irreducible minimum for the amount of heat being transferred, and therefore the Carnot coefficient of performance has come to be regarded as the ultimate standard for heat pump design.

Inasmuch as the Carnot is an ideal unattainable cycle, the vapor compression cycle has been developed as the nearest practical approach to it. Studies have appeared in the literature comparing the Carnot coefficient of performance with ideal vapor compression cycles and with actual commercial compressor designs[3,4]. There has been speculation as to the probable future improvements along these lines. What has been generally overlooked however, in evaluating maximum theoretical heat pump performance is the method by which it has been found necessary to employ these cycles in the use of space heating equipment.

It is the purpose of this paper to analyze such an apparatus thermodynamically, and through the concept of availability, determine the maximum conceivable coefficient of performance regardless of any particular cycle. This will provide a simple method for evaluating a standard against which the various actual or ideal cycles can be compared.

The Steady Flow Heat Pump

Thermodynamically, a heat pump is an apparatus for causing heat to flow from a low temperature energy source or reservoir to a higher temperature space. The natural reservoirs available on earth are the atmosphere, surface water such as rivers or lakes, well water, and the earth itself. In certain situations, artificial or man-made reservoirs such as low temperature waste heat from industrial processes can be used.

Experience has shown that the most practical way to operate a heat pump for space heating is by some steady flow process, schematically shown in Fig. 1. The usual method of extracting energy from the reservoir is to pass the medium of the reservoir itself through the heat pump in steady flow, in which case it would be rejected back to the reservoir at some lower temperature. An obvious exception would be the use of the earth as a reservoir. In this case a refrigerant or other secondary fluid would be circulated through the earth.

Likewise the usual method of supplying heat to spaces consists of circulating air in steady flow from the space, through the heat pump, and back to the space at some higher temperature. An alternate arrangement would be water circulating through radiators, or preferably, low temperature panels. In any event, a fluid is employed which has its temperature raised in passing through the apparatus. (One unique exception would be a panel heating system consisting of a refrigerant condensing in pipes embedded in the walls. At least one such system has been built[5].) Finally, shaft work must be supplied to the apparatus. Electric motors are usually employed for this purpose, but internal combustion engines have also been used to a limited extent[6].

Considered thus in the light of a steady flow process, (Fig. 1) the heat pump may be analyzed as a thermodynamic problem in which work is required to change air from state 3 to state 2, and the reservoir medium from state 1 to state 4.

From thermodynamics it may be seen that the minimum conceivable work required to operate an apparatus in this manner is equal to the increase in *availability* of the respective fluids passing through the apparatus, all with respect to the reservoir state.

The Availability Concept

The heat pump together with the space it is heating may be considered as a system, operating in an environment or reservoir of infinite dimensions. The medium of this reservoir, most conveniently thought of as the surrounding atmosphere, is assumed to be in perfect equilibrium, that is, there is no opportunity for spontaneous work or heat transfer to occur within it. When the system and reservoir together, called the overall system, are in perfect equilibrium, the system is said to be in the dead state. Availability may be defined as the maximum possible work that the overall system can produce when it is in any given state.

Equations for evaluating the availability of any system, either non-flow or steady-flow, can be derived with thermodynamic reasoning based on the First and Second Laws of Thermodynamics. It has

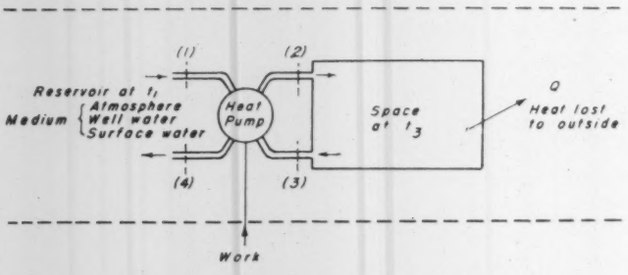

Fig. 1—Schematic diagram of the steady flow heat pump

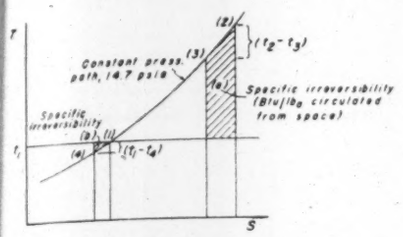

Fig. 2—Temperature-entropy diagram showing inherent irreversibility of the steady flow heat pump

been shown[7] that the availability, A, of a unit steady flow system is expressed by:

$$A = (u_1 + P_1v_1 - T_0s_1 + \frac{V_1^2}{2g} + z_1) - (u_0 + P_0v_0 - T_0s_0 + z_0)$$

or

$$A = (h_1 - T_0s_1 + \frac{V_1^2}{2g} + z_1) - (h_0 - T_0s_0 + z_0) \quad \ldots\ldots (1)$$

where

A = availability (available energy)
u = specific internal energy (internal energy per unit mass)
p = pressure
v = specific volume
T = absolute temperature
s = specific entropy
$\frac{V^2}{2g}$ = specific kinetic energy
z = specific potential energy
$h = u + pv$, by definition (enthalpy)

All units are consistent, and numerical subscripts refer to sections across the steady flow path. The subscript $_0$ refers to the system in the dead state.

It is to be noted that all the terms of Equation 1 are properties of the system, and therefore availability is itself a composite property of a system.

It follows from Equation 1 that when a fluid changes state between section 1 and section 2 (See Fig. 1) along a path of steady flow, the increase in specific availability, ΔA, is

$$\Delta A_{1\text{-}2} = (h_2 - T_0s_2 + \frac{V_2^2}{2g} + z_2) - (h_1 - T_0s_1 + \frac{V_1^2}{2g} + z_1)^*;$$

and if the changes in kinetic and potential energy are negligible for fluids passing through the apparatus:

$$\Delta A_{1\text{-}2} \cong (h_2 - T_0s_2) - (h_1 - T_0s_1)^* \quad \ldots\ldots (2)$$

*Numerical subscripts 1, 2, 3 and 4 refer to states (See Figs. 1, 2 and 6).

For the usual case, where more than one fluid enters and leaves the apparatus, the rate increase in availability, Btu per hour, is equal to the sum of the increase in specific availability of all fluids multiplied by the respective mass rates of flow.

Heat Pump Analysis Based on Availability

The author here proposes to examine in more detail the functioning of the heat pump as a thermodynamic apparatus, the fluids circulating in steady flow, and a method of setting up criteria of performance independent of the capacity of any particular system.

It is apparent that the heat pump operates with certain variables in design conditions. These include types of fluids being circulated, the temperatures of the fluids leaving the apparatus, and the temperatures of the reservoir and the space to be heated. Standard barometric pressure is assumed for all fluids crossing the boundaries of the apparatus.

It can be shown (see Appendix A) that the rates of availability change in all fluids are identical, if the fluid is changing temperature between specified limits, and if energy is being transferred reversibly at a specified rate. Therefore, as a matter of convenience only, air will be used as the working medium both from the reservoir and the space.

With reference to Fig. 1, air temperature at sections 1, 2 and 4 will vary widely with design and operating conditions, while the temperature at section 3 will be assumed to be the 70 F ordinarily used for inside design conditions. Specific humidity of the air, if it remains constant, has no effect on this analysis. If humidification is supplied however, the performance will be affected, but since it can be shown that its effect would be to raise the theoretical coefficient of performance, it will not be considered in this analysis.

The coefficient of performance, CP, of the steady flow heat pump (Fig. 1) is,

$$(\text{CP}) = \frac{\text{effect desired}}{\text{work input}}$$

The effect desired is a supply of energy to the space equal to the heat lost from the space:

$$Q = M_a\,(h_{m_2} - h_{m_3}) \quad \ldots\ldots (3)$$

where,

Q = heat lost from the space, Btu per hour
M_a = weight of air circulated through the space, lb$_a$ per hour
lb$_a$ = pounds of dry air
h_m = enthalpy of moist air, Btu per lb$_a$

The work input will depend upon the construction of the heat pump and its operating cycle, as well as upon the temperature of the fluids entering and leaving. However, for a given set of design conditions, there is an irreducible amount of

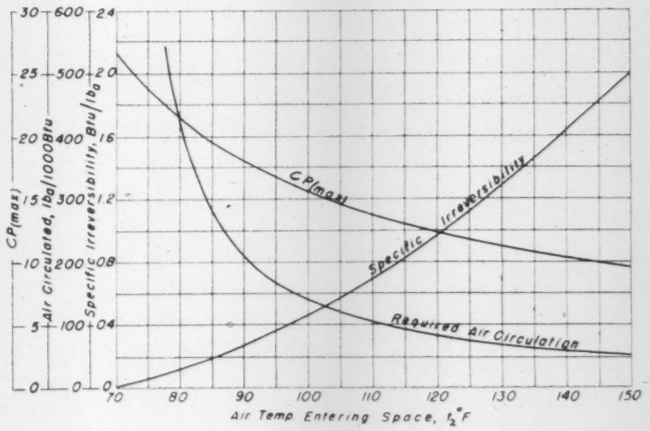

Fig. 3—Performance of an ideal heat pump heating a 70 F space from a 50 F reservoir

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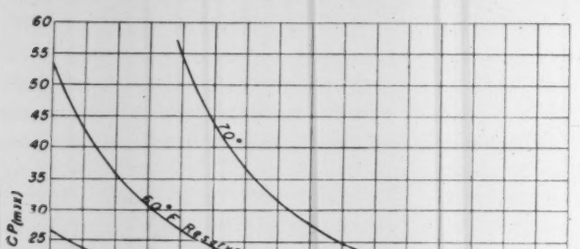

Fig. 4—$(CP)_{max}$ for any heat pump heating a 70 F space from different temperature reservoirs (for the limiting case of isothermal heat transfer from the reservoir)

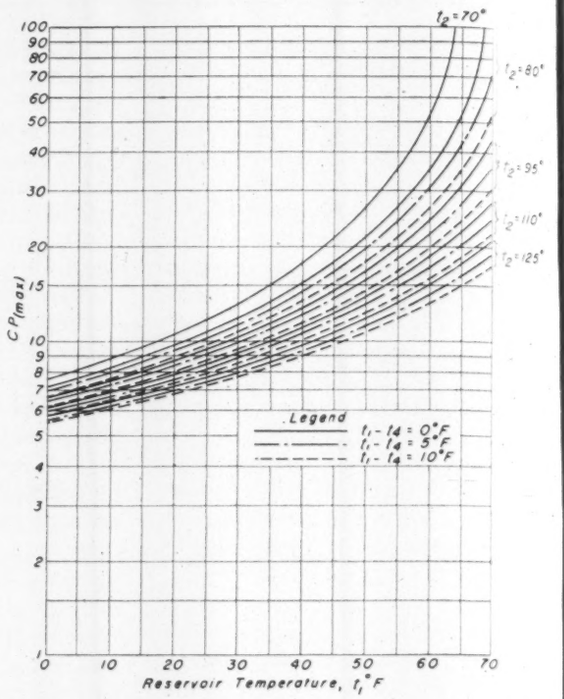

Fig. 5—$(CP)_{max}$ for any heat pump heating a 70 F space from different temperature reservoirs (the temperature t refers to Fig. 1)

work below which a heat pump could not conceivably operate. This minimum work is equal to the rate of availability increase of all the fluids passing through the heat pump and can be evaluated with Equation 2. This follows from the definition of availability, since all processes occuring in the overall system must be reversible for Equation 1 to be valid.

Therefore the maximum conceivable coefficient of performance $(CP)_{max}$ for the steady flow heat pump would be:

$$(CP)_{max} = \frac{M_{a,3}(h_{m,2} - h_{m,3})}{\Delta_3 A_2 + \Delta_1 A_4} \quad \ldots\ldots\ldots\ldots (4)$$

$$= \frac{M_{a,3}(h_{m,2} - h_{m,3})}{M_{a,3}[(h_{m,2} - T_1 s_{m,2}) - (h_{m,3} - T_1 s_{m,3})] + M_{a,1}[(h_{m,4} - T_1 s_{m,4}) - (h_{m,1} - T_1 s_{m,1})]}$$

$$= \frac{(h_{m,2} - h_{m,3})}{\left[(h_{m,2} - h_{m,3}) - T_1(s_{m,2} - s_{m,3})\right] + \frac{M_{a,1}}{M_{a,3}}\left[(h_{m,4} - h_{m,1}) - T_1(s_{m,4} - s_{m,1})\right]} \quad \ldots\ldots\ldots\ldots (5)$$

$$= \frac{c_p\,(t_2 - t_3)}{c_p\,(t_2 - t_3) - T_1 c_p \log_e\left(\frac{T_2}{T_3}\right) + \frac{M_{a,1}}{M_{a,3}}\left[c_p\,(t_4 - t_1) - T_1\,c_p \log_e\left(\frac{T_4}{T_1}\right)\right]} \quad \ldots\ldots\ldots\ldots (6)$$

where,

c_p = specific heat of air at constant pressure, Btu per (pound) (Fahrenheit degree)

t = temperature of air, Fahrenheit

For the limiting case where states 4 and 1 in Fig. 1 are identical and assuming that moist air behaves as a perfect gas,

$$(CP)_{max} = \frac{c_p\,(t_2 - t_3)}{c_p\,(t_2 - t_3) - T_1\,c_p \log_e\left(\frac{T_2}{T_3}\right)} \quad \ldots\ldots\ldots\ldots (7)$$

Inherent Irreversibility in Heat Pump Systems

It has been shown that the minimum work required to change the air streams (Fig. 1) from states 1 and 3 to states 4 and 2, respectively, is a measure of the increase in availability. Likewise, the decrease in availability of the air streams in changing back to their original state would be a measure of the maximum work that could be produced by the overall system. The difference between the maximum work and the actual work that results during a change of availability in a system is a quantitative measure of irreversibility. The air at state 4 is mixed with air in the reservoir, and the air at state 2 is mixed with air in the space. Obviously no work results. The process is irreversible, and consequently the irreversibility per pound of air circulated is equal to the increase in availability per pound of air circulated.

This is illustrated in Fig. 2. The crosshatched area is proportional to the irreversibility per pound of air circulated (specific irreversibility). Numerically, it is equal to the denominator of Equation 5, with the exception that area (b) should be multiplied by the ratio $M_{a,1}/M_{a,3}$ to obtain consistent units of Btu per pound of air circulated through the space.

For any assigned temperatures in Fig. 2, the irreversibilities (a) and (b) are inherent and unavoidable. The practical way of minimizing this loss is to bring t_2 and t_4 as

close as possible to t_3 and t_1 respectively. There are certain limitations involved here, however. The heat loss from a building is a constant, and as shown by Equation 3, any lowering of temperature t_2 (and consequently $h_{m,2}$) must be accompanied by an increase in the quantity of air circulated, M_a. In the limiting case when t_2 approaches t_3, M_a approaches infinity. In this case Equation 7 becomes indeterminate and can be evaluated mathematically in the following manner:

$$(CP)_{max} = \frac{(T_2 - T_3)}{(T_2 - T_3) - T_1 \log_e\left(\frac{T_2}{T_3}\right)} = \frac{0}{0} \text{ (when } T_2 = T_3)$$

$$\lim_{x \to a} \frac{f(x)}{\phi(x)} = \lim_{x \to a} \frac{f'(x)}{\phi'(x)}$$

$$\lim_{T_2 \to T_3} (CP)_{max} = \frac{f'(T_2 - T_3)}{\phi'[T_2 - T_3 - T_1 (\log_e T_2) + T_1 (\log_e T_3)]}$$

$$= \frac{1}{1 - \frac{T_1}{T_2}} = \frac{T_2}{T_2 - T_1} \qquad \ldots\ldots (8)$$

where T_3 and T_1 are constants

This is the Carnot Cycle coefficient of performance as applied to the heat pump, and is to be expected since all irreversibility has disappeared and the apparatus is operating between a constant temperature source and receiver.

Although it is not apparent from a casual inspection of Fig. 2, a given temperature drop $(t_1 - t_4)$ at the reservoir will always cause more irreversibility, Btu per hour, and will consequently cause a lower maximum coefficient of performance than the same temperature rise $(t_2 - t_3)$ for air entering the space. This can best be shown by examining the denominator of Equation 6. When $(t_2 - t_3) = (t_1 - t_4)$ then $\log_e T_2/T_3$ will always be smaller than $\log_e T_1/T_4$. In other words, for the case where $M_{a,1} = M_{a,2}$ and for a given temperature drop Δt_4; there is more irreversibility than for the same temperature rise Δt_2; under this condition, area (b) would be greater than area a, Fig. 2. It can be shown that values of $M_{a,1}/M_{a,3}$ other than unity would not alter this conclusion.

This is a fortunate circumstance since practical considerations make it feasible to operate with a temperature drop $(t_1 - t_4)$ much smaller than temperature rise $(t_2 - t_3)$.

Evaluating Maximum Coefficient of Performance

Case a. Where $t_1 = t_4$ and $t_2 > t_3$ (See Fig. 1): Fig. 3 shows the limiting performance of any heat pump heating a space at 70 F from a reservoir at 50 F, for an entering air temperature range from 70 F to 150 F, and where isothermal extraction of energy from the reservoir is assumed. Such a condition could be approximated by an actual heat pump using an evaporator so as to pass reservoir fluid (air or water) over the coil in sufficiently large quantities so that the temperature drop would be negligible.

It is noted that the inherent irreversibility decreases from a maximum at $t_2 = 150$ F to zero at $t_2 = 70$ F, but that the corresponding quantity of air required to be circulated through the space increases very rapidly at values of t_2 below 90 F to 100 F. The limiting value of t_2 in practice is usually determined by the maximum air changes possible without creating drafts.

Sample calculations for Case a.

Design Conditions $\begin{cases} t_1 = t_4 = 50 \text{ F} \\ t_2 = 95 \text{ F} \\ t_3 = 70 \text{ F} \end{cases}$

The specific irreversibility, from the denominator of Equation 7, equals

$$c_p (t_2 - t_3) - T_1 c_p \log_e\left(\frac{T_2}{T_3}\right)$$

$$= 0.241\left[(25) - 509.7 \log_e\left(\frac{554.7}{529.7}\right)\right]$$

$$= 0.360 \text{ Btu/lb}$$

The air circulated M_a, from Equation 3, is:

$$M_a = \frac{Q}{h_{m,2} - h_{m,3}}$$

For air this becomes:

$$M_a = \frac{Q}{c_p (t_2 - t_3)} = \frac{1000}{0.241 (95\text{-}70)}$$

$$= 166.0 \text{ lb}_a \text{ per 1000 Btu heat lost from the space}$$

The maximum conceivable coefficient of performance $(CP)_{max}$, from Equation 7, becomes:

$$(CP)_{max} = \frac{(t_2 - t_3)}{(t_2 - t_3) - T_1 \log_e\left(\frac{T_2}{T_3}\right)}$$

$$= \frac{(95\text{-}70)}{(95\text{-}70) - 509.7 \log_e\left(\frac{554.7}{529.7}\right)}$$

$$= 16.73$$

For the limiting case, where $t_2 = t_3$, from Equation 8:

$$(CP)_{max} = \frac{T_2}{T_2 - T_1} = \frac{529.7}{20}$$

$$= 26.48$$

Fig. 4 is supplementary to Fig. 3 in that $(CP)_{max}$ is given for additional reservoir temperatures ranging from 70 F down to —20 F.

Case b. Where $t_4 \leq t_1$ and $t_2 \geq t_3$. (See Fig. 1): This is the more general condition of heat pump operation and in this case Equation 6 can be used to evaluate $(CP)_{max}$. It is to be remembered that although Equation 6 is valid only for a perfect gas the resulting $(CP)_{max}$ will represent the limiting performance of any heat pump operating with the temperatures designated, regardless of the composition of the circulating fluids.

However, before Equation 6 can be used, it is necessary to evaluate the unknown, $(M_{a,1}/M_{a,3})$ from the known temperatures in the following manner:

Let $Q_{(in)} = M_{a,1} c_p (t_1 - t_4)$;

and $Q_{(out)} = M_{a,3} c_p (t_2 - t_3)$;

where

Q_{in} = heat transferred to the heat pump.

Q_{out} = heat transferred from the heat pump.

In the derivation of Equation 1 it is shown that the maximum work done by any system in changing to the dead state will be that done by a reversible engine. Similarly, the minimum work required to raise the availability of a fluid would be that supplied by a reversible heat pump. Consequently the *rate* of entropy decrease, Btu per Fahrenheit degree, for the fluid flowing between

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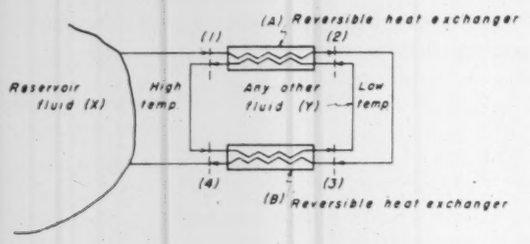


Fig. 6—Rate of availability change between two fluids

states 1 and 4 is equal to the *rate* of entropy increase, Btu per Fahrenheit degree, for the fluid flowing between states 3 and 2. This must be true since no other heat crosses the boundaries of the heat pump and all processes are assumed to be reversible. Symbolically:

$$-\Delta_1 S_4 = \int_4^1 \frac{dQ_{(in)}}{T} = \int_4^1 \frac{M_{a,1}\, c_p dt}{T}$$

$$\Delta_3 S_2 = \int_3^2 \frac{dQ_{(out)}}{T} = \int_3^2 \frac{M_{a,2}\, c_p dt}{T}$$

and therefore:

$$M_{a,1}\, c_p \log_e \left(\frac{T_1}{T_4}\right) = M_{a,2} c_p \log_e \left(\frac{T_2}{T_3}\right)$$

or

$$\frac{M_{a,1}}{M_{a,3}} = \frac{\log_e (T_2/T_3)}{\log_e (T_1/T_4)} \quad \ldots\ldots\ldots (9)$$

substituting (9) in Equation 6

$$(CP)_{max} = \frac{c_p (t_2 - t_3)}{\left[c_p (t_2 - t_3) - T_1 c_p \log_e \left(\frac{T_2}{T_3}\right)\right] + \frac{\log_e (T_2/T_3)}{\log_e (T_1/T_4)} \left[c_p (t_1 - t_4) - T_1 c_p \log_e \left(\frac{T_4}{T_1}\right)\right]}$$

$$= \frac{(t_2 - t_3)}{(t_2 - t_3) - \frac{\log_e (T_2/T_3)}{\log_e (T_1/T_4)} \times (t_1 - t_4)} \quad \ldots\ldots\ldots (10)$$

Fig. 5 shows the $(CP)_{max}$ for any heat pump heating a space at 70 F from any reservoir down to 0 F. Four entering air temperatures, t_2 = 80, 95, 110, and 125 F, are included, and for each one of these conditions, performances are shown for three temperature drops to the reservoir, $(t_1 - t_4)$ = 0, 5, and 10 F. A curve showing the $(CP)_{max}$ for the limiting case, $t_1 = t_4$ and $t_3 = t_2$, is shown for comparative purposes. Values for $(CP)_{max}$ for design conditions other than those shown can be estimated by interpolation.

Sample calculations for case (b).

Design conditions $\begin{cases} t_1 = 50\text{ F} & t_4 = 40\text{ F} \\ t_3 = 70\text{ F} & t_2 = 95\text{ F} \end{cases}$

From Equation 10,

$$(CP)_{max} = \frac{(95\text{-}70)}{(95\text{-}70) - \frac{\log_e (554.7/529.7)}{\log_e (509.7/499.7)} \times (50\text{-}40)}$$

$$= 14.53$$

Summary and Conclusions

Experience has shown that the practical way to design and operate a heat pump is as a steady flow apparatus in which fluids enter and leave the equipment with falling or rising temperatures. The amount of temperature change in these fluids will depend on their mass rates of flow which are limited by factors such as permissible air changes, friction drop, noise, circulating fan and pump horsepower.

The minimum conceivable work required to change the state of these fluids between specified limits can be evaluated by calculating their change in availability.

Thus, a relatively simple method can be used for evaluating the performance for the various ideal and operating heat pump cycles of common engineering installation. Such an evaluation will show that the ideal simple vapor compression cycle falls far short of the maximum theoretical coefficient of performance. Various complex vapor compression cycles show considerable improvement in this regard, and the maximum possible coefficient of performance can be attained by certain ideal gas (air) cycles. A study of a number of such cycles has been made, and it is proposed to publish these results at a later date.

APPENDIX A

Rates of Availability Change in Fluids

The rates of availability change in all fluids having a constant specific heat are identical, if the fluid is changing temperature between specified limits, and energy is being transferred at a specified rate. This can be demonstrated by reference to Fig. 6.

Fluid (X) has its availability decreased in passing through reversible heat exchanger (A) from high temperature state 1 to low temperature state 2. However, fluid (Y) has its availability increased in passing from state 2 to 1. Inspection shows that these two changes in availability are occurring at equal rates (but not necessarily equal per pound of fluid circulated) since another reversible heat exchanger (B) could be employed to change the availability of fluid (X) from state 3 back to the reservoir value. But fluid (Y) is *any* fluid of constant specific heat and therefore the product of the mass rate of flow, pounds per hour, and the change in availability, Btu per pound, is a constant, irrespective of the fluid.

Bibliography

1. The Power Required for the Thermodynamic Heating of Buildings, by Sir William Thomson (Lord Kelvin). (*Cambridge and Dublin Mathematical Journal*, November, 1853.)

2. Principles and Practice of the Heat Pump, by C. W. Chamberlain. (*Refrigerating Engineering*, Vol. 32, August 1938, pp. 97-102.)

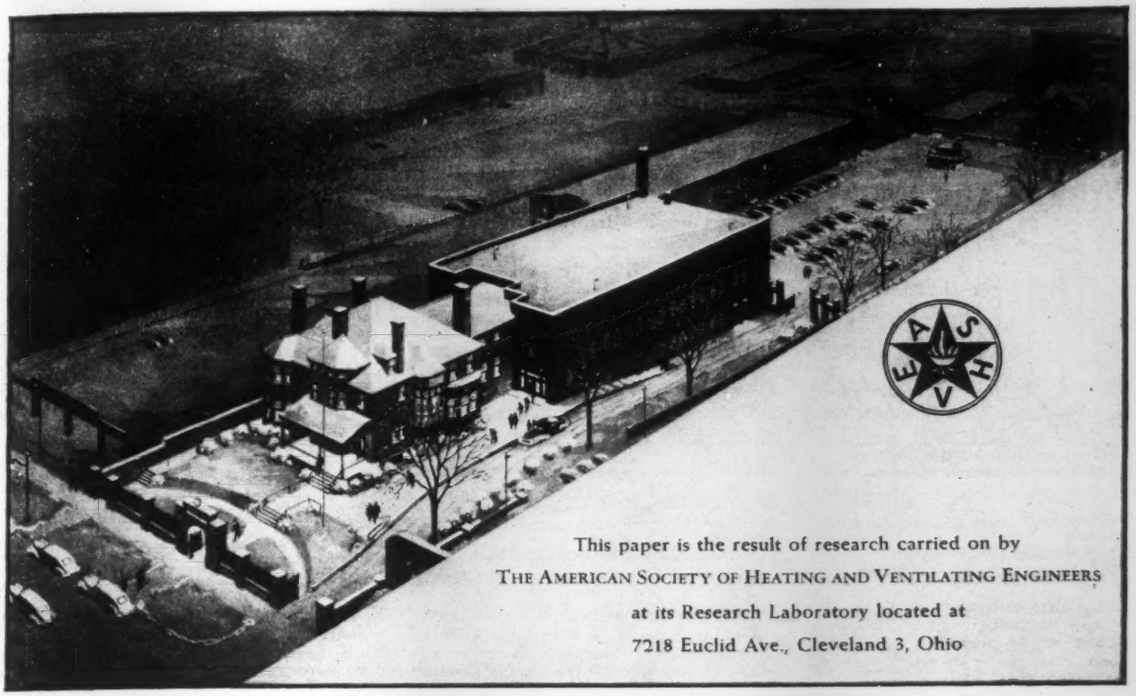
3. Heat Pumps, by Philip Sporn, E. R. Ambrose, and T. Baumeister. (John Wiley and Sons, Inc., New York, 1947.)

4. Coefficient of Performance of the Heat Pump, by W. Parkerson. (*Heating and Ventilating*, Vol. 44, May, 1947, pp. 63-67.)

5. Warming Walls by Reverse Cycle, by T. F. Wall. (*Electrical West*, Vol. 83, October, 1939, p. 48.)

6. The Heat Pump Engine Drives, by K. W. Miller and N. C. Penfold. (*Electrical Engineering*, Vol. 67, April, 1948, pp. 344-347.)

7. Thermodynamics, by J. H. Keenan. (John Wiley and Sons, Inc., New York, Chapter 17, 1947.)



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THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
at its Research Laboratory located at
7218 Euclid Ave., Cleveland 3, Ohio

Solar Energy Transmittance of Eight-Inch Hollow Glass Block

By George V. Parmelee* and Warren W. Aubele**, Cleveland, Ohio

SUMMARY — This report presents solar energy transmitting characteristics of five patterns of eight-inch hollow glass blocks. Data on heat conduction through the panel under steady state natural weather conditions are given. Transmittance curves and suggested tables of solar angles for design use are presented.

A CONTINUING program of research to develop design heat flow data for glass in its various architectural forms has been carried on since 1944 at the ASHVE Research Laboratory under the direction of the Committee on Research and the TAC on Heat Flow Through Glass.† Previous papers[1,2] have given solar energy transmittance data for single sheets and various combinations of two sheets of flat glass. This paper presents similar data on five common patterns of eight inch glass block.

The problem of heat flow through a glass block panel to or from an enclosure is one of great complexity with respect to both heat conduction through the panel and the transmittance of short wave length radiant energy. Heat conduction through the panel is affected by outdoor and indoor boundary conditions of which solar energy is one. The solar energy transmitting characteristics are affected by the size of the individual block, the face patterns, the absorption characteristics of the glass, the shading effect of the mortar joints and the energy distribution of the incident solar radiation.

The principal purpose of this research report is to present solar energy transmitting characteristics. Data on heat conduction through the panel under steady state natural weather conditions are given. The problem of heat flow from the inside surface of the panel to the indoor surroundings as it is related to solar irradiation is considered only to the extent of giving approximate values of the magnitude and time of occurrence of peak heat gain. Further experimental work and analysis are required before a complete solution of this problem can be presented, especially with regard to relating instantaneous heat gains to system load.

Experimental Procedure

The Calorimeter

Except for some minor changes the calorimeter used in these studies and the instrumentation were essentially as described in some detail in previous reports.[1,2,3] Fig. 1 shows a glass block panel in place for test. In February 1949 a convection-compensated radiometer

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[1] Exponent numerals refer to References.

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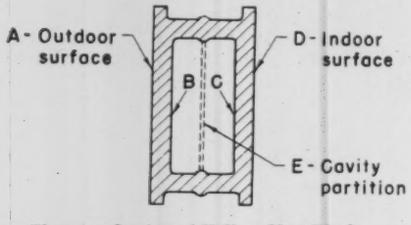
Table 1—Description of Glass Block Patterns



Elevation Section of Hollow Glass Block to Indicate Location of Surface Patterns

Type I —Smooth Face
A, D: Smooth
B: Wide vertical ribs or flutes
C: Wide horizontal ribs or flutes
E: None
Type II —Semi-Light Diffusing
A, D: Narrow vertical ribs or flutes
B, C: Etched or stippled
E: None
Type III—Light Diffusing
A, D: Narrow vertical ribs or flutes
B, C: Etched or stippled
E: Glass fiber screen
Type IV—Light Diffusing
A, D: Close pitch deep horizontal corrugations
B, C: Vertical light diffusing prisms
E: None
Type V —Light Directing
A, D: Close pitch deep vertical corrugations
B, C: Horizontal Light directing prisms
E: None

was installed to measure the long wave length radiation from the ground surroundings and the sky that is incident on the panel area.

The Test Panels

The blocks were set in wood frames using a sand-cement mortar to which a small amount of lime was added to improve consistency. Standard anchors and wall ties were set in the joints at intervals designated by the manufacturers. The description of the panels appears in Table 1.

Temperature Measurements

Measurement of the panel surface temperature was an essential part of the experimental technique. The panel area was divided into four squares of equal area. A single centrally located block in each of two diagonally located areas was selected for thermocouple installation. On each of these blocks, five thermocouples were cemented into shallow grooves cut into the block. Two other couples were located in the mortar joint adjacent to the block. The paralleled reading of 10 couples in the block and a similar observation of four couples in the mortar joint, weighted for relative area of glass and exposed mortar joint, gave the average panel surface temperature.

Table 2—Transmittances of Glass Block Samples for Normally Incident Solar Radiation

A. Computed from Spectro-photometric Data for Spectral Range 0.30 — 2.10 Micro...[a]

Sample	Thickness In.	Values for Sample Tested		Values Adjusted to ¼-In. Thickness	
		Transmittance	Avg. *KL*	Avg. *KL*	Transmittance
A	0.496	0.870	0.0491	0.0247	0.892
B	0.494	0.816	0.1232	0.0622	0.859

B. Measured in Sunlight with Smithsonian Silver Disk Pyrheliometer

Sample	Date of Test	Thickness In.	Values for Sample Tested		Values Adjusted to ¼-In. Thickness	
			Trans-mittance	Avg. *KL*	Avg. *KL*	Transmittance
A-1	7-15-48	0.166	0.89	0.022	0.033	0.89
A-1	8 -9-48	0.166	0.88	0.037	0.057	0.86
A-2	8- 9-48	0.215	0.88	0.036	0.039	0.88
B-1	7-15-48	0.292	0.87	0.053	0.046	0.87

[a]Based upon Moon's[4] energy distribution for air mass = 2; ordinates at 0.05 micron intervals.

Results Obtained

Spectral Transmittance Characteristics

Flat polished samples of glass made from the same melts that were used to manufacture the glass block on which the heat flow studies were made were subjected to spectro-photometric tests. With these data transmittances for normally incident solar radiation were computed for two typical samples. The results are given in Table 2, part A. The average value of KL (the product of absorption coefficient K, per inch, and thickness, L, inches) for each sample was determined and used to compute the KL and the transmittances for a ¼ in. thickness. The transmittance, τ, is related to KL, as follows:

$$\tau = e^{-KL} / 1.094$$

where

e = the Naperian base of natural logarithms.

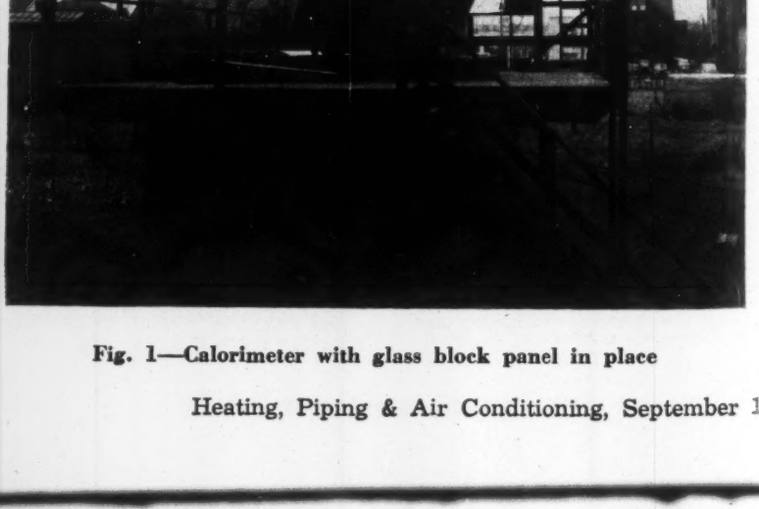


Fig. 1—Calorimeter with glass block panel in place

Part B of the same table gives the results of pyrheliometer tests made on samples taken from the blocks themselves.

Transmittance of Diffuse Solar Radiation

Table 3 lists the diffuse radiation transmittance of the five glass block panels tested. These were obtained by means of the calorimeter apparatus, and are averages of no less than six tests conducted at temperatures such that heat leakage corrections were at a minimum.

Table 3—Transmittance of Diffuse Solar Radiation by Eight-Inch Glass Block Panels

(Measured by calorimeter)

Panel Type	Transmittance	
	Range	Average
I	0.22-0.33	0.27
II	0.18-0.32	0.27
III	0.11-0.26	0.19
IV	0.09-0.22	0.15
V	0.13-0.21	0.16

Transmittance of Direct Solar Radiation

To determine these values fixed angle tests were run in such a way as to determine effects of the mortar joint. One set of tests was run with the panel in such position that at all times the sun's rays lay in a plane which was perpendicular to the panel and parallel to the vertical mortar joints. This is referred to as Case I. In these tests the shading effect was due only to the horizontal mortar joints. In a second set of tests, referred to as Case II, the sun's rays lay in a plane which was perpendicular to the panel but parallel to the diagonal line across the panel. Here both vertical and horizontal mortar joints shaded the glass opening. The results of these tests are shown in Fig. 2.

Because pattern effects are combined with mortar joint shading, the area within each pair of curves does not necessarily represent all the transmittances possible for any one angle of incidence. To include all possibilities test data were plotted on polar coordinates with the radial scale as azimuth-difference angle and the angular position as solar altitude. The azimuth-difference angle is the angle between the projections of a wall and of the sun's rays on a horizontal plane. The solar altitude is the angle between the sun's rays and a horizontal plane. The values from the fixed angle tests were plotted together with test results from fixed position tests with south, southwest, and west orientations. These data gave a sufficient number of points so that lines and areas of constant transmittance could be drawn. Fig. 3 shows the smoothed iso-transmittance curves for the five panels. Fig. 4 illustrates the agreement between the curves for Type I and the test points.

Heat Gains From Absorbed Solar Energy

A considerable portion of the incident solar radiation may be absorbed by a glass block panel, resulting in a rise in temperature of the outdoor and indoor surfaces. Part of this absorbed energy is stored in the panel, part is lost from the indoor surface by convection and radiation, and the rest is lost to the outdoor surroundings by ra-

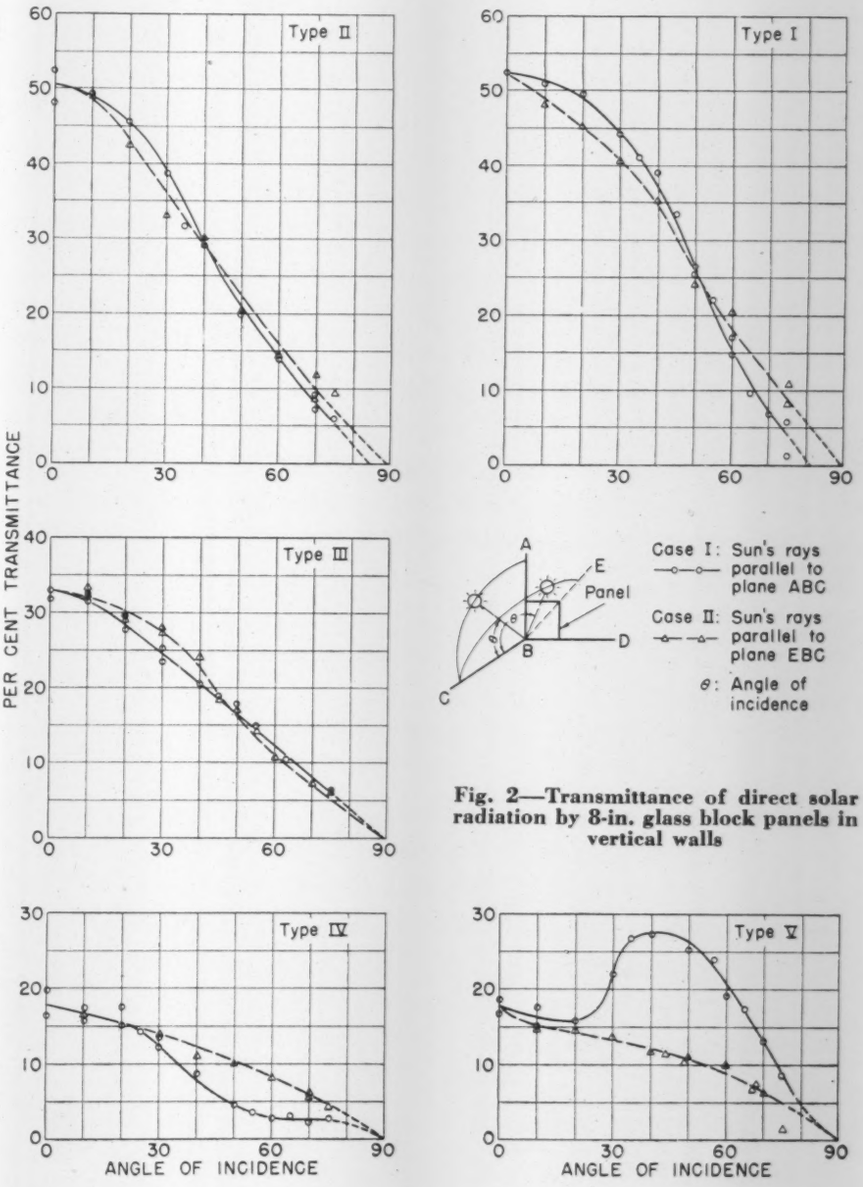


Fig. 2—Transmittance of direct solar radiation by 8-in. glass block panels in vertical walls

diation and convection. The fraction absorbed depends upon:

1. The area and absorptivity of exposed mortar joints,
2. The angle of incidence,
3. The path length of the reflected and transmitted rays, and
4. The absorption coefficient of the glass.

The mortar joints, with the adjacent glass webs, form a path of relatively high thermal conductivity to the indoor side. The angle of incidence determines to a considerable extent the amount of radiation which passes through the outdoor surface only to be trapped in the interior by the mortar joints. The fraction of the absorbed energy which leaves the indoor surface depends upon the indoor and outdoor boundary conditions for radiative and convective heat transfer and the heat capacity of the panel. The latter tends to diminish the amplitude of the heat wave and causes it to lag behind the time occurrence of the external effect which produces it.

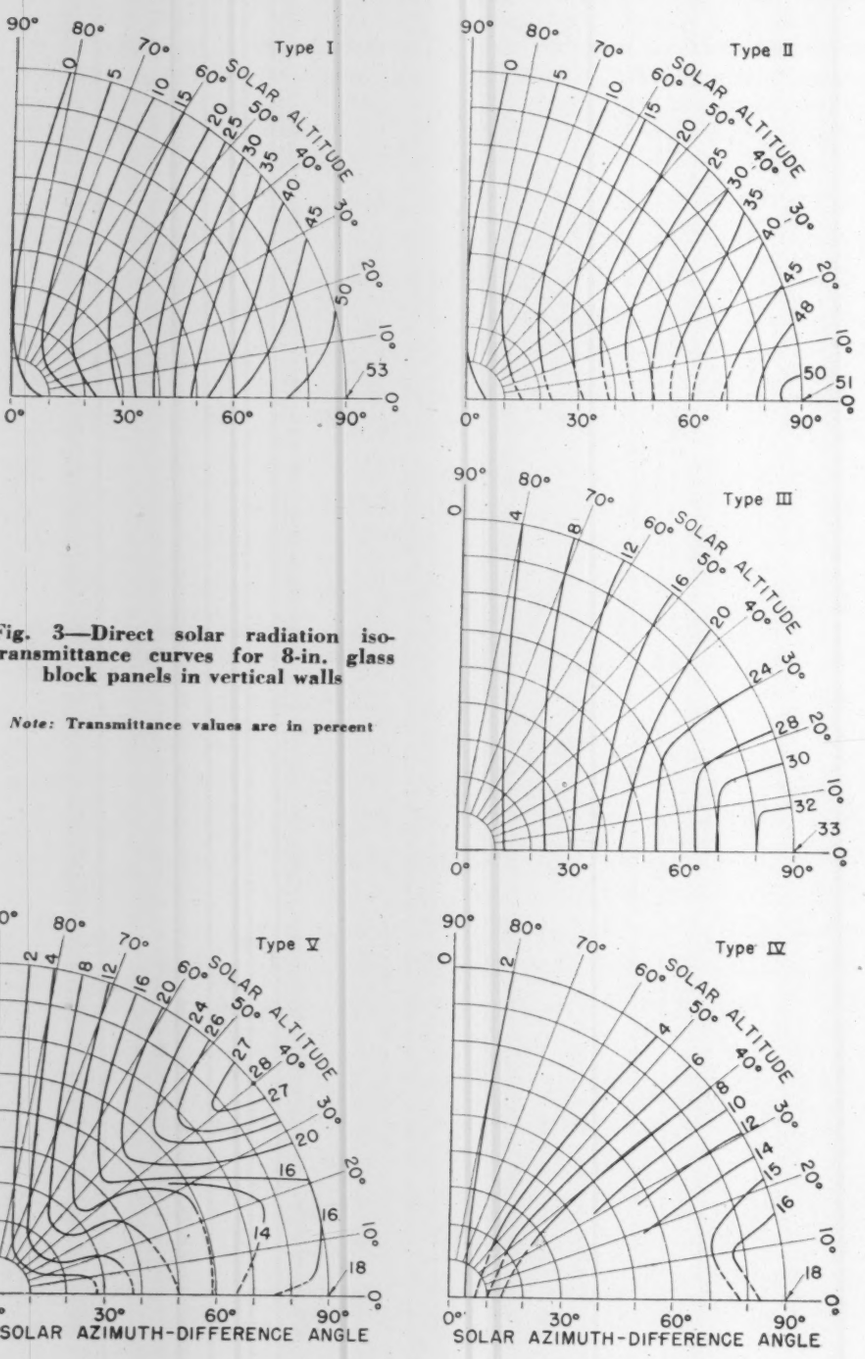


Fig. 3—Direct solar radiation iso-transmittance curves for 8-in. glass block panels in vertical walls

Note: **Transmittance values are in percent**

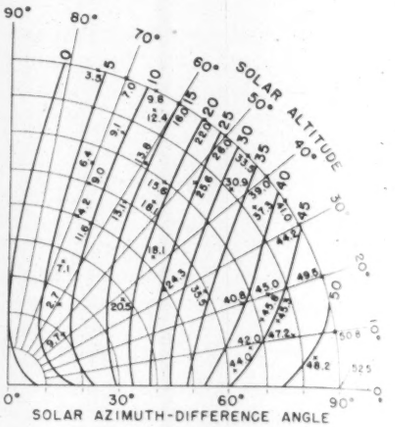


Fig. 4—Comparison of test data with iso-transmittance curves for 8-in. Type 1 block

In order to determine the diurnal cycle of solar heat gain, a number of tests have been made in which a panel was held in a fixed position. Most of these tests were started before sunrise and were continued until after sunset. Data were taken at 15-min intervals.

It is not possible at this time to present an analysis of the heat gain due to solar energy absorption and its relationship to the factors previously mentioned. Instead approximate values are given of the fraction of the incident solar energy that is dissipated from the indoor surface at the time of maximum total heat gain. This fraction has been determined by treating the data obtained in the fixed position tests in the following manner. The heat gain by the calorimeter via radiation and convection from the indoor surface of the test panel was computed in Appendix A (to be published with paper in ASHVE TRANSACTIONS, Vol. 55, 1949). This quantity was then adjusted to a zero indoor-outdoor temperature differential by multiplying the value of U for the panel (see the next section) by the differential existing under test conditions. This product was added or subtracted if the outdoor temperature was lower or higher respectively than the indoor temperature. A second adjustment

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was made for the effect of absorbed diffuse radiation on heat gain by convection and radiation. The corrected value was then divided by the incident direct radiation. These results and the approximate time the peak gain occurs during midsummer at about 40 deg north latitude are presented in Table 4. Also listed is the fraction of the incident diffuse solar radiation which passes indoors by way of absorption and conduction. These values have also been corrected to zero indoor-outdoor temperature differential. The fraction of direct radiation transmitted at the time of maximum heat gain and the fraction of diffuse radiation transmitted are also listed.

Table 4—Approximate Fraction of Incident Solar Radiation Which Enters an Enclosure at Time of Maximum Rate of Heat Entry Through 8-Inch Glass Block *(Zero Indoor-outdoor temperature differential; August 1; 40 deg north latitude)*

Block Type	Orientation	Direct Incident Radiation				Diffuse Radiation		
		Approx. Hour (Sun Time)	Fractional Gain			Fractional Gain		
			Conv. & Rad. (Approx.)	Trans. (Measured)	Total (Approx.)	Conv. & Rad. (Approx.)	Trans. (Measured)	Total (Approx.)
I	South	1 p.m.	0.23	0.10	0.33	0.10	0.27	0.37
	West	5 p.m.	0.18	0.45	0.63			
II	South	1 p.m.	0.23	0.10	0.33	0.10	0.27	0.37
	West	5 p.m.	0.18	0.42	0.60			
III	South	1 p.m.	0.20	0.08	0.28	0.10	0.19	0.29
	West	5 p.m.	0.21	0.27	0.48			
IV	South	1 p.m.	0.17	0.03	0.20	0.15	0.15	0.30
	West	5 p.m.	0.19	0.15	0.34			
V	South	1 p.m.	0.17	0.14	0.31	0.15	0.16	0.31
	West	5 p.m.	0.18	0.17	0.35			

Overall Coefficients of Heat Transfer and Panel Conductances

Table 5 lists the results of tests made out-of-doors to determine overall coefficients and panel conductances. Following previous practice[3] the overall coefficient of heat transfer, U, is based upon the heat flow through the panel per square foot area divided by the temperature difference between the calorimeter *surface* and the outdoor air. The panel conductance, C, is the same heat flow quantity divided by the temperature difference between the indoor and outdoor surfaces. In the tests weather conditions were stable enough so that the panel was in thermal equilibrium with its surroundings for a period of several hours. The tabular values for these tests are averages of several one hour periods during which readings, taken at fifteen minute periods, showed no significant change.

The heat flow quantities were determined by averaging the results of two computations. In one the radiation exchange and convection heat transfer between the calorimeter surface and the indoor side of the test panel were computed. The second was determined from the heat supplied to the calorimeter by the fluid system minus the heat leakages. The calculations follow the general procedure outlined for computing solar energy transmittances as given in Appendix A (to be published with paper in ASHVE TRANSACTIONS, Vol. 55, 1949). In addition small corrections, based upon heat meter measurements, were made to account for heat leakage at the perimeter of the panel. The two values checked within 2 to 7 percent.

Solar Energy Transmittance

In order to understand the contributions of face patterns and mortar joints to the transmitting characteristics of a given glass block panel, it is of interest to compare test results with computed results. Consider the transmittance of an eight inch block consisting of two ¼-in. thick faces, 7¾ in. sq, flat and parallel and connected by 3¾ in. webs ½ in. wide. Such a block corresponds roughly to Type I, which has a fairly simple pattern on the cavity surfaces only. The average thickness of the block faces is approximately ¼ in. Table 2 shows that at normal incidence, glass of this thickness transmits about 88 percent of normally incident radiation. The corresponding transmittance of the two faces is 77.5 percent; that of the web is 46 percent. The block as a whole would transmit about 66 percent. The corresponding transmittance of the Type I panel is 52.5 percent. A small part of the difference is due to the fact that the web area, measured at the outer surfaces, is not fully effective as transmitting area. The remain-

Table 5—Over-All Coefficients of Heat Transmission, U, and Conductances, C, of Glass Block Panels

Date of Test	Time E.S.T.	Block		Wind		Sky Condition	Temperatures (Fahrenheit)					Heat Flow Btu per (hr) (sq ft)	C Btu per (hr) (sq ft) (F deg)	U Btu per (hr) (sq ft) (F deg)
		Type	Size In.	Velocity mph	Angle of Incidence Deg		Calorimeter		Panel Surfaces		Outdoor Air			
							Surface	Air	Indoor	Outdoor				
4-5-49	1:00–5:15 a.m.	I	6	3.0	45	Clear	74.2	73.0	58.6	43.7	39.1	17.6	1.18	0.50
3-7, 8-49	10:45 p.m.–3.30 a.m.	I	8	3.5	0	Clear	72.3	70.9	56.0	37.7	31.9	18.0	0.98	0.45
3-16-49	7:00–8:15 p.m.	III	8	8.5	Sheltered	O'cast	74.1	72.9	59.0	35.7	29.3	17.2	0.74	0.38
3-23, 24-49	11:00 p.m.–2:30 a.m.	III	8	3.1	0	O'cast	75.5	74.5	62.4	44.6	37.0	14.5	0.81	0.38
2-28 to 3-1-49	10:45 p.m.–1:00 a.m.	V	8	7.8	90	O'cast	71.6	69.7	50.3	27.1	19.2	25.4	1.09	0.48

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der of the difference probably can be attributed to the face pattern itself. Inspection shows that there are small areas of total or partial reflection distributed over the surface.

The shading effect of the mortar joints will now be discussed. To simplify the problem, the panels will be considered as made up of 7¾ in. squares of flat glass 3¾ in. apart with the glass web and mortar joint partitions replaced by thin non-reflecting partitions. Fig. 5 shows the computed transmittances for such a panel. Curve A is the transmittance curve for two sheets of ¼ in. glass. Curve B shows the shading effect of a single joint (Case I) and curve C shows the shading effect of two mortar joints (Case II). Curves D and E are the Case I and Case II curves of Fig. 2 for the Type I block adjusted for the mortar joint area. At angles of incidence in excess of 30 deg, the agreement is reasonably good in spite of pattern effects. This agreement can be explained by two facts: (1) if there had been a web in the ideal block, about half of it would have been eliminated as transmitting area by the shading effect of the joint, (2) the cavity surfaces are actually fair reflectors so that the rear or indoor surface of the block receives and transmits radiation that otherwise would never have reached it. This probably accounts for the fact that zero transmittance occurs at higher incident angles than would be predicted from the geometry of the block.

The curves for the Type IV and Type V block are extreme examples of the effect of face pattern. This is especially true of the Type V block, which has horizontal light directing prisms on the cavity faces. A drawing board analysis was made for incident angles of zero and 45 deg. The problem of tracing the rays through the block was simplified by considering the outer surface to be flat. It was found that at normal incidence roughly 75 percent of the incident radiation was totally reflected. The reflected rays left the front face at an angle of about 20 deg so that one would expect the transmittance at 20 degrees incident to be about the same as at zero incidence. The Case I curves are in agreement with this analysis. At 45 deg there was little reflection except that normally associated with the various glass-air boundaries. The rays were bent upwards at an angle therefore tending to counteract the shading effect of the mortar joint. The result was that at 45 deg the transmittance was about the same as for the Type I block.

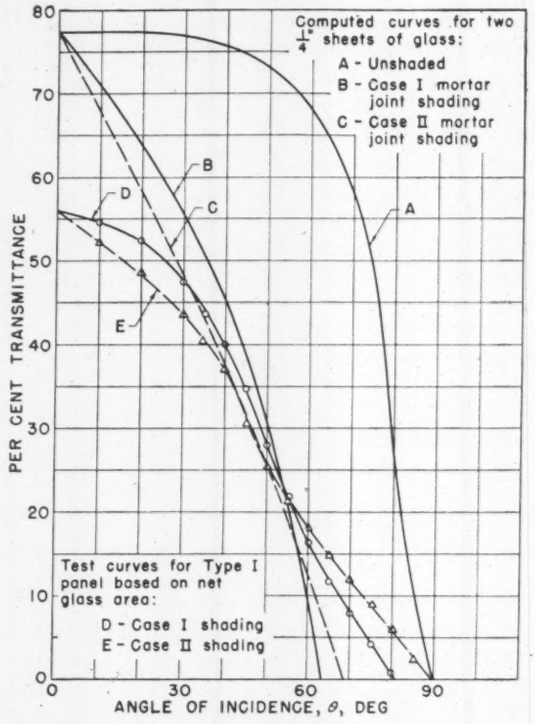

Fig. 5—Computed transmittance for 8-in. block compared with transmittances of Type 1 panel

The curves for the Type IV block show that the face pattern, designed to diffuse the incident radiation, reduces the transmittance to very low levels. The similarity of the Case II curve of this block and that of the Type V block is striking, but not at all unexpected. In both cases the pattern presented to the sun's rays was essentially the same. Test data for the Type IV panel in the region of low solar altitude and the middle values of azimuth-difference angle were not extensive enough to permit extrapolation. Information recently received from the field indicates that the Type IV panel is often installed rotated 90 deg from the position in which the panel was set in the calorimeter. Until additional data are secured, the *curves as presented should be used only for installations corresponding to the test conditions.*

The pattern of Type II affects the transmittances about as would be expected and shows that its diffusing nature reduces the transmittance rather little as compared to Type I. The addition of a glass fiber screen, on the other hand, (Type III) markedly reduces the transmittance.

Use of the Transmittance Curves

Fig. 3 makes it possible to select the transmittance of vertical panels for any orientation, location and time of day. With suitable data relating direct solar intensity to solar altitude, the amount of solar radiation transmitted can be determined satisfactorily. In view of the data given in Table 2, it is believed that the effect of variations in the distribution of solar energy on transmittance is not large.

When solar intensity data can be

correlated with other weather design data, design tables of instantaneous rates of heat gain can be made up for each block type for various localities throughout the country. As an interim measure and one offering some degree of flexibility, it is suggested that Fig. 3 be used with tables such as Tables 6 and 7. Table 6 gives the solar altitudes and cosines of the incident angle for variously oriented vertical walls at 40 degrees north latitude with a solar declination of 18 degrees north (Aug. 1). Table 7 gives solar altitudes and the azimuth-difference angles for the same latitude and season. Use of these tables for any time between May 1 and August 15 will not lead to serious error. These tables are similar to Tables 8 and 22 of Chapter 15 of the HEATING, VENTILATING, AIR CONDITIONING GUIDE 1949.

Fig. 6 presents several curves (B, C and D) of direct solar radiation intensity on a plane normal to the sun's rays, plotted against air mass which, at sea level and standard pressure, corresponds to the solar altitudes given on the right hand ordinate. Air mass at any solar altitude may be found from curve A Fig. 6. For elevations above sea level the air mass corresponding to a given solar altitude is reduced in direct proportion to the barometric pressure for the given station. Values given by curve B are in most cases identical with those in Table 5 Chapter 15 of THE GUIDE 1949 and are the basis of the present tables of design solar heat gain for single ordinary window glass. The curves for Cleveland illustrate to some extent the variations in intensity possible on cloudless days. With data such as these and Table 6 the irradiation of a wall can be readily computed.

The diffuse intensity on a vertical wall used in Table 18 of THE GUIDE is of the order of 20 Btu per (hr) (sq ft). It is of interest to note that similar values were observed in Cleveland in 1948 when the solar intensity was somewhat in excess of curve B. On the other hand the diffuse values associated with curve

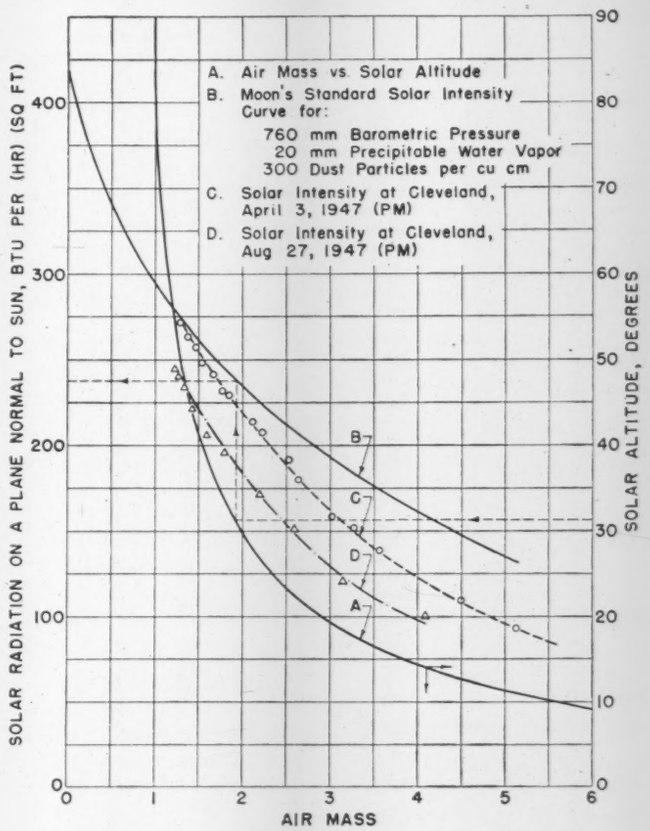

Fig. 6—Intensity of direct solar radiation on clear days at Cleveland

Table 6—Cosine of Incident Angle for Variously Oriented Vertical Walls and a Horizontal Plane and Solar Altitude

(For 18 deg declination north (Aug. 1) and 40 deg north latitude)

Local Mean Sun Time		Solar Altitude Deg	Orientation of Wall						
A.M.→ ↓			N	NE	E	SE	S	SW	Horiz.
5	7	0.5	0.406	0.934	0.914	0.358			0.010
6	6	11.5	0.237	0.840	0.951	0.505			0.199
7	5	23.0	0.079	0.705	0.919	0.594			0.388
8	4	34.5		0.533	0.824	0.631	0.069		0.564
9	3	45.5		0.337	0.673	0.614	0.196		0.713
10	2	56.0		0.129	0.475	0.542	0.292		0.830
11	1	64.5			0.246	0.424	0.354	0.076	0.903
12		68.0			0.000	0.265	0.375	0.265	0.927
	↑ P.M.→		N	NW	W	SW	S	SE	Horiz.

Table 7—Azimuth-Difference Angle, Degrees, for Variously Oriented Vertical Walls and Solar Altitude

(For 18 deg declination north (Aug. 1) and 40 deg north latitude)

Local Mean Sun Time		Solar Altitude, Deg	Orientation of Wall					
A.M.→ ↓			N	NE	E	SE	S	SW
5	7	0.5	24	69	66	21		
6	6	11.5	14	59	76	31		
7	5	23.0	5	50	85	40		
8	4	34.5		40	85	50	5	
9	3	45.5		27	74	61	16	
10	2	56.0		14	59	76	31	
11	1	64.5			35	80	55	10
12		68.0			0	45	90	45
	↑ P.M.→		N	NW	W	SW	S	SE

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D were of the order of 40 Btu per (hr) (sq ft). An example illustrating the use of Fig. 3 and Tables 6 and 7 may now be given.

Find the solar energy transmitted by a wall of Type I block facing southwest at 2 p.m. sun time.

From Table 6 the cosine of the incident angle is 0.542; the solar altitude is 56 deg. From Fig. 6 the standard direct solar intensity on a normal plane is 280 Btu per (hr) (sq ft); on the vertical plane it is 0.542 times 280 or 151.7 Btu per (hr) (sq ft). From Table 7 the azimuth-difference angle is 76 deg. For this angle and an altitude of 56 deg, the transmittance is 0.18. From Table 3 the diffuse transmittance for this type of block is 0.27. The total solar energy transmitted is 0.27 times 20 plus 0.18 times 151.7, or a total of 32.7 Btu per (hr) (sq ft). It should be realized that this instantaneous gain does not necessarily produce an equal instantaneous load on the system because of internal heat storage effects.

Total Heat Gain

It is emphasized that the values of solar energy gain by convection and radiation from the indoor surface as given in Table 4 are rough approximations only. Although most of the values were determined directly from test conditions, the boundary conditions governing heat transfer by radiation and convection and the cyclic variation in solar intensity were by no means identical.

Therefore the values for one type of block do not necessarily indicate its performance relative to another type or even the same block with another orientation. Further analysis of the data is required to determine with more precision the relationship of heat gain to boundary conditions.

As pointed out in previous papers and elsewhere in the literature, the heat gain data determined by these tests are instantaneous rates of heat release to a conditioned enclosure. Because of the quick response of the apparatus they were also instantaneous cooling loads on the calorimeter system. This is far from true in actual installations. Because the interior structure stores up much of the solar energy directly transmitted by a glass block panel and that emitted by the panel as low temperature radiation, the load imposed on a cooling system is ordinarily much less than the instantaneous heat gain from the panel. The effect varies with the distribution of radiant energy transmitted by the panel, the heat capacity of the structure, and the method of cooling.

Overall Coefficients of Heat Transmission

Because overall coefficients of heat transmission are dependent upon the indoor and outdoor boundary conditions for convective and radiative heat transfer, the fundamental heat conducting characteristic of a given glass block panel is best indicated by its conductance. Inspection of the data of Table 5 shows that the conductances of eight inch block panels, with the exception of Type III, average about 1.1 Btu per (hr) (sq ft) (F deg). Since wind velocity and direction and radiation exchange affect the surface temperature distribution, the panel conductances may be dependent to some extent on these influences. This is indicated by the values given for the Type III block and shows that additional tests would be desirable.

The conductance of the Type III panel is markedly lower because of the glass fiber screen which divides the cavity. This screen principally affects the transfer of radiant energy across the cavity. Since the air pressure in the cavity is approximately one-third of an atmosphere, the convection heat transfer across the cavity is probably so small that the addition of the screen can have but little effect.

Summary

Transmittances of five eight-inch glass block panels have been determined for direct and diffuse solar radiation by calorimeter tests. Transmittance curves and suggested tables of solar angles for design use have been presented. Estimates of the amount and time of maximum solar heat gain for south and west walls have been given. Overall coefficients of heat transmission have been determined under steady state, natural weather conditions by means of the calorimeter apparatus. The results of the investigations may be summarized as follows:

1. The shading effect of the mortar joints is a principal factor in establishing the solar energy transmitting characteristics of glass block panels, except in the case of prism-type blocks. Increasing obscurity of pattern design and use of screens reduce energy transmittance proportionately.
2. The light directing characteristics of the prism-type blocks cause their transmitting characteristics to depart considerably from the trend indicated by mortar joint shading.
3. Heat gain data due to absorbed solar energy must be recognized as approximations that are subject to considerable variation and therefore must be used with caution.
4. If design boundary conditions of heat transfer had existed during the tests, values of overall coefficients for glass block panels would be somewhat higher than those presented. The possible influence of boundary conditions on panel conductance needs further study.

Acknowledgment

The authors acknowledge with thanks the assistance and counsel given by their colleagues of the ASHVE Research Laboratory staff, the contribution of the American Structural Products Co. and the Pittsburgh-Corning Corp. in providing technical data and assistance, and the help of the members of the ASHVE Technical Advisory Committee on Heat Flow through Glass for stimulating interest in the project, and also providing both suggestions for procedure and technical information.

References

1. ASHVE RESEARCH REPORT—Measurements of Solar Heat Transmission Through Flat Glass, by G. V. Parmelee, W. W. Aubele and R. G. Huebscher. (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, Vol. 20, No. 1, January, 1948, p. 158.)

2. ASHVE RESEARCH REPORT — Solar and Total Heat Gain Through Double Flat Glass, by G. V. Parmelee and W. W. Aubele. (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, Vol. 20, No. 6, June 1948, p. 116.)

3. ASHVE RESEARCH REPORT—Overall Coefficients for Flat Glass Determined Under Natural Weather Conditions, by G. V. Parmelee and W. W. Aubele. (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, Vol. 20, No. 12, December, 1948, p. 111.)

4. Proposed Standard Solar Radiation Curves for Engineering Use, by P. Moon, (*Journal of the Franklin Institute*, Vol. 230, No. 5, November, 1940, p. 583.)

DISCUSSION

J. N. LIVERMORE, Detroit, Mich., suggested that the authors should make an effort to separate radiant and convected heat released from the interior surfaces of the glass block exposed to sunshine. He also suggested that the paper should include a practical example of the method to be followed in applying the heat transfer data given in the paper.

Written discussions of the paper were received from H. B. Vincent, Toledo, Ohio; E. W. Conover, Detroit, Mich.; J. P. Stewart, Syracuse, N. Y.; A. H. Baker, and D. D'Eustachio, both of Port Allegany, Pa.

MR. VINCENT stated that the authors had been very modest in describing the instrumentation and measurement procedure. He felt that the improvements which the authors had made in the instrumentation and testing technique were extremely important in improving the precision of measurement and facilitating duplication of results. He suggested care in applying the information presented in the paper to actual structures because the measurement device used for the tests described differs fundamentally from a structure designed for occupancy. Further work will be required in developing methods of application of the data obtained by test.

MR. CONOVER pointed out the need for developing a simplified method of calculation for design purposes. He requested amplification of a number of points, and questioned the correctness of the method of computing the approximate fraction of incident solar radiation values shown, presented in Table 4, and using values of U obtained during night tests. He believed that the value of U should be different for panels heated by solar radiation. Mr. Conover pointed out that the values of U given in Table 5 were determined by night tests, and since wind velocities were low, a correction should have been made for conditions of a 15-mile wind outside, and natural convection on the room side. Mr. Conover also inquired about the method used of determining the air pressure existing in the cavities of the Type III panel.

MR. STEWART stated that the authors had added another valuable chapter to the information on solar transmission through glass materials. He pointed out the agreement obtained between transmittance values measured by the pyrheliometer and the values computed from spectro-photometric data. It was suggested that the heat gain through glass block be arranged in some simplified tabular form suitable for use in THE GUIDE.* Mr. Stewart also asked whether the approximate time lag in convection and radiation heat flow through the glass block could be obtained for heat gain due to direct incident radiation.

MR. BAKER pointed out that spectral transmittance curves had been obtained for various glasses used in the tests described in this paper. The general purpose was to determine what effect the spectral transmittance of the glass would have upon the overall solar energy transmittance of the glass block wall construction. He therefore suggested that the spectral transmittance curves be presented, and that the authors express their significance.

MR. D'EUSTACHIO pointed out that since great care had been taken to obtain reliable data, the results should be reduced to a form applicable to practice as rapidly as possible. The variation in characteristics of block patterns from those listed in Table 1 should be determined. Correction should also be given for effect of placing blocks with corrugations in a vertical rather than horizontal position. It was also mentioned that a single test which might be used to classify new block designs into the present grouping would be desirable.

CYRIL TASKER gave a brief resumé of the work being conducted at the ASHVE Laboratory to determine solar heat transmission through various materials.

AUTHORS' CLOSURE: In reply to Dr. Baker, the authors submit Fig. A, spectral transmittance curves of glass samples, ½ in. thick, made from the melts used in the manufacture of the blocks studied at the Laboratory. The normal incidence transmittances are seen to be relatively constant over that part of the solar spectrum which contains most of the sun's energy, namely, 0.4 to 1.0 microns. Therefore, one would expect that differences in the energy distribution of the incident radiation would affect the transmittance values no more than the probable percentage of error in the determinations with the calorimeter apparatus. This percentage of error is estimated to be of the order of 3 to 5 percent, and is dependent somewhat upon test conditions. Possible exceptions to this statement are the Type IV and Type V blocks where the transmittance is reduced by the reflection characteristics of the cavity prisms. At some angles the path length becomes long enough, due to internal reflections, so that the absorption is high and transmittance much lower in the infra red than in the visible portion of the spectrum.

Mr. Conover quite properly questions the correctness of adjusting to a zero

*HEATING, VENTILATING, AIR CONDITIONING GUIDE (published by AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, 51 Madison Ave., New York N. Y.).

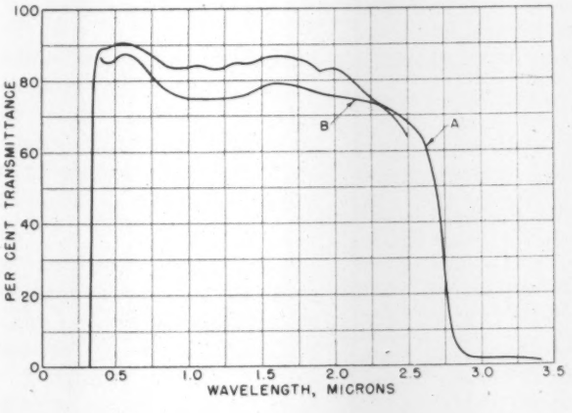
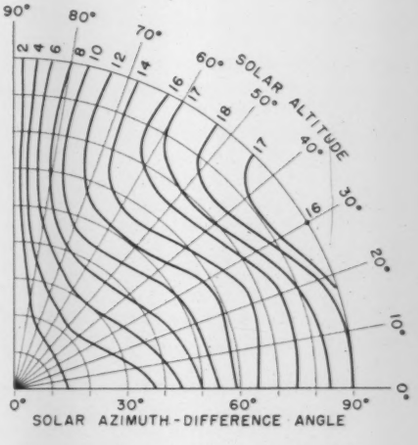


Fig. A—Spectral transmittance curves of flat polished ½ inch thick glass of composition typical of commercial glass block



Note: Transmittance values are in per cent.

Fig. B—Iso-transmittance curves for Type IV block with prisms horizontal

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indoor-outdoor temperature differential the gain by convection and re-radiation from sunlit panels by using *U* values from night tests. Our data on outdoor surface conductances are not yet so accurate that much refinement is justified at this time. In making the adjustment no attempt was made to allow for differences in wind velocity and radiant exchange conditions. In all cases the adjustment was of the order of 5 to 10 Btu per (hr) (sq ft) except for the panel of Type III block. The fractional gain values for this block must be regarded as being subject to considerable possible error because 30 to 50 deg temperature difference existed in these tests. Though expressing radiant and convected heat gain data as fractional values of the incident radiation is a convenient method when one is concerned with peak heat gain, it has little value for later hours of the day because of time lag effects. After sundown this fraction can become infinite.

Mr. Conover states that the data on overall coefficients indicate that THE ASHVE GUIDE values of *U* may be too low. Since the panel conductances are low, a considerable increase in surface conductances will cause a relatively smaller increase in the *U* value. There also is still some question as to how much a given change in surface conductance will affect panel conductance. More data must therefore be obtained to determine what changes can be made in THE GUIDE values.

The approximate pressure of the block cavity was obtained from the manufacturers and presumably was estimated from a knowledge of the temperature of the block at the time the two halves are pressed together for sealing.

Whether the description of curves of Fig. 5 explains disagreement instead of agreement is probably a matter of point of view. A better understanding of mortar joint shading and pattern effects would have been obtained had a clear block been studied. Perhaps this can be done as a part of future work.

There is no direct reference in THE GUIDE to the value of 20 Btu per (hr) (sq ft) diffuse irradiation of vertical surfaces used in making up the data for single window glass in Table 18, Chapter 15 of THE GUIDE 1949. This is approximately the value agreed on by C. M. Ashley and the senior author when the former prepared a revision of Chapter 15 some years ago and the latter prepared Table 18. Actually the value was made to vary with solar altitude.

In reply to Mr. D'Eustachio's comments regarding the transmitting characteristics of the Type IV block when the corrugations are vertical, the authors submit Fig. B. This shows iso-transmittance curves for this type block with the corrugations vertical, that is, prisms horizontal. Additional test work completed after the paper was submitted for publication made it possible to give more complete data on this block than was given in the paper. Considerable computation is required to transpose curves obtained for a given block in one position to curves that show its performance in a position which is 90 deg from the first.

The authors can suggest no wholly satisfactory single test that could be used to classify new block designs into the present grouping of five types. However, since light is in some ways easier to measure, it might be possible to insert a single block in the opening of an integrating chamber surfaced with a non-reflective light sensitive material. If this surface were calibrated in terms of the light source, transmittance might be determined for various angles. The convection and radiation gain could be closely estimated from the data for the block which applies most closely to the unknown.

Mr. Livermore suggests that the radiant heat and the convected heat released from the interior surfaces of the sunlit glass block be separated to facilitate relating instantaneous loads to apparatus load. This has been done in working up the test data for this report and all previous reports. A sample set of data given in the Appendix to be published in the TRANSACTIONS shows these computations. In the calorimeter apparatus used, the convected and radiated heat are roughly in the ratio of one to five. Convection is low because air motion is due entirely to natural means. In actual buildings the air motion due to air distribution systems would cause this ratio to be more nearly one to two.

The authors would like to have elaborated on the results given in the paper and to have shown how the data might be applied to actual engineering problems. An attempt was made to illustrate the use of the iso-transmittance curves, the solar intensity curves, and the tabular values of altitude and azimuth difference angle. However, lack of space and the necessity of meeting a deadline made it impossible to do more than this.

In reply to Mr. Stewart, the convection and radiation heat flow lagged by about one hour behind the incident radiation curve for south and west walls. The fact that curves C and D of Fig. 6 are both below Moon's Standard Solar Intensity curve does indicate that for the Cleveland area Moon's design curve, which is used in THE GUIDE 1949, is too high for days which produce the greatest cooling loads. On the other hand, for many parts of the country Moon's suggested intensity values are too low.

Mr. Vincent's question with regard to classifying other designs into the categories set up in the paper is in the same vein as Mr. D'Eustachio's. For those patterns currently manufactured it would seem that most would fall into Type I or Type II. For example, those with a simple pattern or no pattern at all could be classed in Type I with the transmittances between zero and 25 deg incident angle adjusted upward a bit in the case of block with no pattern.

The patterns with prisms are much more difficult to classify, since transmittance appears to be so dependent upon prism angle and orientation. For example, the Type IV block with prisms horizontal is, for all practical purposes, an entirely different block than the same block with the prisms vertical.

Mr. Vincent quite properly points out that the input to the cooling system is not readily recognizable from the instantaneous heat flow data. Professors Mackey and Gay in their paper *Heat Gains Are Not Cooling Loads* enable one to make some estimate of the influence of internal storage effects on heat gain of a radiant nature.

PERSONALS

Paul D. Gayman has been appointed manager of the Western district of Johnson Service Co., with

Paul D. Gayman

headquarters at Milwaukee. Mr. Gayman has been manager of the Cleveland branch since 1938. He is a past president (1943-44) of Northern Ohio Chapter of ASHVE.

Frank J. McCusker has been appointed sales representative of the Fitzgibbons Boiler Co., Inc., in the Philadelphia area, according to **John R. Collette**, manager of field sales for Fitzgibbons. Mr. McCusker joins **Edgar N. Black, III,** and **William Wetherstine, Jr.,** in the Philadelphia office.

Resultant Temperature and Its Measurement†

A Summary of Two Danish Papers

By Vagn Korsgaard*, Copenhagen S., Denmark

SUMMARY—*Resultant temperature* is introduced as a useful quantity for the analysis of heat-exchange conditions in spaces where the thermal field involves the simultaneous influence of both radiation and convection. Simple instruments are described for its direct measurement.

FUNDAMENTAL research carried on in Denmark during recent years has produced results which are of general value in the analysis of the thermal field in rooms, particularly with panel heating. Two very interesting papers will be briefly summarized here. The first paper[1] deals with the definition of *resultant temperature* and the basic requirements which must be fulfilled by an instrument to measure this temperature. The second paper[2] presents the operating principles, construction details and calibration methods for two different forms of *resultant temperature* thermometers.

Introductory familiarity with *resultant temperature* as a physical quantity may be had by recognizing it as the indoor equivalent of the sol-air temperature[3] which has been employed in the United States for several years. Resultant temperature thermometers are merely alternative, somewhat refined, and calibrated versions of the sol-air thermometer[4].

Summary of the First Paper

This paper presents a precise, generalized development of the resultant-temperature concept. The author describes the thermal conditions within a room by means of what he calls the *thermal field* of the room. This thermal field is properly specified only in terms of the pattern of *resultant temperature* throughout the space; and since the resultant temperature at a point may vary widely with the direction from the point, this specification requires a sequence or distribution pattern of values having both *magnitude* and *direction*. The thermal field of a room is further characterized by using the term *source;* for example, the thermal conditions in an evacuated room with uniform inside surface temperature are described as a *one-source thermal field.* If the room were not evacuated there would exist a *two-source thermal field.* If the different parts of the inside surface have different temperatures there would be a *many-source thermal field,* with one *source* localized to the room air and one *source* localized to each of the different parts of the inside surface at different temperatures.

In a room with a q-source thermal field, the thermal conditions are governed by q thermal sources. Between any one of these thermal sources and a unit area A_m having the temperature v_m a partial heat flow is maintained, the magnitude of which for the arbitrary thermal source is H_p. This heat flow is determined by the temperature difference $(v_p - v_m)$ and by the thermal resistance R_p of the heat flow path, as seen from the resistance form of the usual equation for heat flow,

$$R_p \left(\frac{H_p}{A_m}\right) = (v_m - v_p) \quad \ldots\ldots (1)$$

It is shown[1] both by physical considerations and by analysis that it is possible to substitute for all q partial flows a single quantity $H_I = (H_1 + H_2 \ldots H_p + \ldots H_q)$ called the *resulting heat flow* which is imagined to proceed from a *fictive source* with temperature v_I defined as the *resultant temperature* of the room with respect to the unit area A_m. This resulting heat flow will pass through a *resulting thermal resistance* R_I.

The following equations for determining the resulting thermal resistance and the resultant temperature are derived[1].

$$R_I = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \ldots \frac{1}{R_p} + \ldots \frac{1}{R_q}} \quad \ldots\ldots (2)$$

$$v_I = \left(\frac{v_1}{R_1} + \frac{v_2}{R_2} + \ldots \frac{v_p}{R_p} + \ldots \frac{v_q}{R_q}\right) R_I \quad \ldots\ldots (3)$$

It is pointed out that the resultant room temperature v_I is not a quantity universally characterizing the room, but that it *only characterizes the thermal properties of the room relative to a given unit area.*

†This paper and two previous papers (published in ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning,* June and July 1949) are based on theoretical and experimental work performed by the author in 1945 at the Heating and Ventilating Research Laboratory of the University of Technology of Copenhagen, Denmark, on a scholarship from the Council of Technical-Scientific Research of Denmark, and written while in residence at the ASHVE Research Laboratory, March 24 to June 25, 1948.

*Fellow of the American-Scandinavian Foundation and mechanical engineer.

[1]Exponent numerals refer to references.

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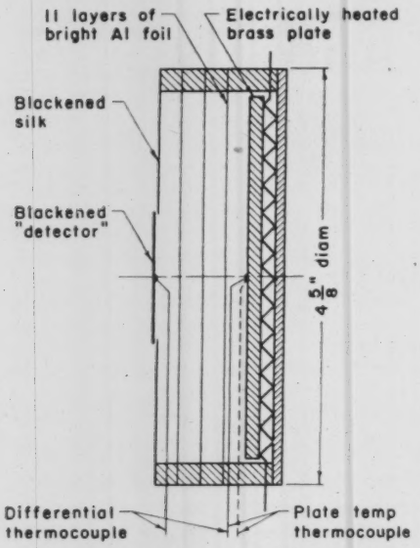

Fig. 1—Resultant thermometer with compensation

Regarding the measurement of the resultant temperature of a room it is stated[1]:

The measurement is carried out with the aid of a thermometer, the principle, as in all thermal measurements, being that of bringing the thermal feeler or *detector* of the measuring apparatus (thermometer bulb, thermocouple junction and the like) into thermal equilibrium with the surrounding field.

Principles for accomplishing this may be set forth.

One-source thermal field

The measurement is independent of the shape and orientation of the thermometer detector and may therefore be carried out by means of, for example, an ordinary fluid thermometer.

Two-source thermal field

An ordinary thermometer is usually inadequate for the determination of the resultant room temperature in a two-source thermal field because the results of measurements in this kind of field to some extent are dependent on the shape and size of the thermometer detector. The room temperature is measured relative to the detector, and the size and shape of this detector will, if the air in the room is moving, affect R_e (the thermal resistance for convection), which in turn is one of the components determining the resultant room temperature. Therefore, if temperature measurements in two-source thermal fields are to be reproducible and comparable to measurements undertaken elsewhere they must necessarily be carried out with the aid of *identical thermometers of standard type.*

Three- and many-source thermal-fields

In thermal fields of this kind the results of measurements are dependent not only on the size and shape of the thermometer detector, but also on its orientation; and here too, for the reasons just mentioned, it will be necessary to employ a thermometer of standard type. Such thermometers most advantageously should have a flat detector of standardized size, shape and surface finish, the face of which alone is thermally sensitive, while its back should be completely heat-insulated in order that no thermal impulses may penetrate through from the back side and affect the detector. Suggestions for a standard resultant thermometer meeting these requirements are dealt with in the second paper[2]. It is stated that,

By measurement with a resultant thermometer it is possible to chart completely the thermal field of a room by determining the room's *resultant temperatures* relative to the thermometer detector for any point in the room and in any direction. This procedure is presumably the best means by which to carry out a satisfactory technical-scientific study on the thermal characteristics of a room.

Summary of the Second Paper

The resultant thermometers described in this paper are designed in accordance with the fundamental principles given in the first paper; hence,

The resultant temperature determined by means of a resultant thermometer is measured relative to a surface unit, namely that of the flat detector of the thermometer, which is in thermal equilibrium with the surroundings. Inasmuch as the back of the detector is completely heat-insulated and hence thermally insensitive, the resulting heat flow H_I (determined by the Equation 1) passing through the detector will be zero, whence follows that $v_I = v_m$, i.e. the resultant temperature is measured directly relative to a unit area of surface of the same temperature.

The first type described is a resultant thermometer with compensation schematically shown in Fig. 1. Here the thermometer detector (a thin plate of blackened copper foil stuck to the flat front of the apparatus) is insulated towards the back by multiple layers of bright aluminum foil with narrow air spaces in between. To compensate completely for heat flow from the detector towards the back an electrically heated brass plate is maintained at the same temperature as the detector plate; this is assured by means of a thermocouple with one junction on the detector plate and one on the brass plate. When the apparatus has reached thermal equilibrium with the surroundings the temperature of the detector plate, or what is the same, the temperature of the brass plate, is measured by means of a thermocouple with the *hot* junction fastened to the brass plate and the *cold* junction in ice water in a thermos bottle.

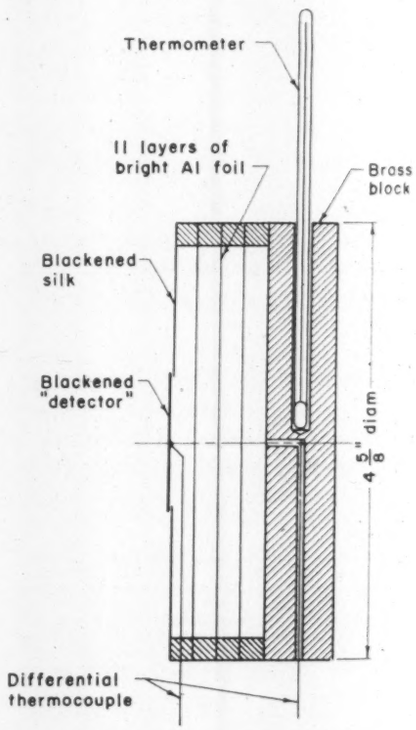

Fig. 2—Resultant thermometer without compensation

The resultant temperatures measured by means of this thermometer in a known thermal field show good agreement with those obtained theoretically.

The other type described is a resultant thermometer without compensation, schematically shown in Fig. 2. It is stated that,

A resultant thermometer of this kind, when the back of the detector is not completely impervious to heat, will show a resultant temperature different from the actually prevailing temperature. By measuring with this apparatus in a thermal field whose governing thermal sources (with their temperatures and thermal resistances) are known, it is possible to determine a correction for the readings of the thermometer. The magnitude of this correction will depend on the quantity of heat that passes from the back of the detector through the insulative layer, which quantity can be expressed by the temperature difference between the detector and the rear plate of the apparatus. Experiments have established the wide applicability of this simple instrument since it has been found that such a correction curve could be determined with sufficient accuracy.

Some introductory measurements with the resultant thermometer, dealing with the influence of diffuse daylight on the thermal field, are cited to show that the diffuse daylight penetrating through the windows of a room may have a considerable influence on the thermal field of the room.

In some remarks regarding the applicability of the resultant thermometer it is said that,

The range of application of the resultant thermometer is not confined to measurement of thermal fields in rooms. The resultant thermometer will likewise prove useful for the determination of the outside resultant temperature which is of importance when determining the heat loss from a building, since, with its direction-determined readings, it will be capable of showing the structure of thermal field in open air. For the computation of the heat loss from buildings this furnishes a base which is far better than any other method so far available, where one has to rely on the temperature of the air. Measurements of this kind may be included in our scheduled investigations**.

**Such measurements have been carried out during the past year with special designed weather-proof resultant thermometers at the University of Technology of Copenhagen.

Reviewer's Note

The papers reviewed will be available in English from Danmarks Tekniske Hoejskoles Laboratorium for Opvarnming og Ventilation, Oestervoldgade 10, Copenhagen K, Denmark.

References

1. On Thermal and Calorific Fields in Buildings, by F. C. Becker. (Meddelelser fra Danmarks tekniske Hoejskoles Laboratorium for Opvarnming og Ventilation, Vol. 1, 1945, pp. 3-22.)

2. On the Construction of Resultant Thermometers and Some Introductory Measurements with These Instruments, by N. F. Bisgaard. (Meddelelser fra Danmarks tekniske Hoejskoles Laboratorium for Opvarnming og Ventilation, Vol. 1, 1945, pp. 23-47.)

3. ASHVE Research Report No. 1255—Periodic Heat Flow—Homogeneous Walls or Roofs, by C. O. Mackey and L. T. Wright, Jr. (ASHVE Transactions, Vol. 50, 1944, p. 293.)

4. ASHVE Research Report No. 1298—The Sol-Air Thermometer—A New Instrument, by C. O. Mackey and L. T. Wright, Jr. (ASHVE Transactions, Vol. 53, 1946, p. 271.)

Health Aspects of Air Pollution*

by A. J. Lanza, M.D.,** New York, N. Y.

This discussion of air pollution is concerned with the general atmosphere of communities. In factories, workshops, mines and all other places where men are gainfully employed, air pollution occurs, but it is possible to control such pollution and in fact control the air itself by washing or cleansing it and by regulating its temperature, humidity and movement. Man's knowledge has progressed to the point where he is able to establish standards, expressed in terms of maximum allowable concentrations, for the protection of industrial workers.

Presumably pure air is air containing only its chemical components in proper proportion and free from any air-borne foreign substances whatever. Pure air can possibly be found on mountain tops and in mid ocean, but wherever man goes or congregates he pollutes the air, first of all by the process of breathing and secondly by his habits and customs.

Nature has constructed the breathing apparatus of man so that it is a fairly effective filter of extraneous matter that may be suspended in the air. During the centuries before the industrial era, man breathed air contaminated by foreign particles arising from the surface of the earth and stirred up by wind, by agricultural pursuits and by such processes of nature as pollination of trees and flowers.

Man has survived, not only because of his own defensive mechanism but because the movement of air has diluted his various exposures to air-borne substances sufficiently to render them harmless, or at least tolerable.

Now, however, because of the enormous expansion of industry and methods of heating homes and buildings, man is in many instances faced with the realization that he cannot continue to rely entirely on the benign effects of nature for protection.

In industry most occupational diseases are air-borne. Examples of poisonous substances causing such diseases are: lead and mercury, representing the metallic group; benzol, representing the solvents; and carbon monoxide and sulphur dioxide, the lethal gases. The action of these substances may produce an acute illness, whereas silicosis, caused by silica, is basically a chronic illness of long duration. Thus, deleterious substances in the general atmosphere may be a possible cause of acute or chronic illness.

*Extract of talk presented at 42nd Annual Conference, *Smoke Prevention Association of America*, Birmingham, Ala.—May 24, 1949.

**Chairman, Institute of Industrial Medicine, NYU—Bellevue Medical Center.

Number of new cases of cancer per 100,000 white population per year with primary location in the lungs and the respiratory system by sex for selected cities.††

City	Lung		Total Respiratory	
	Male	Female	Male	Female
Philadelphia	14.8	3.1	25.1	4.4
Alameda and San Francisco	11.5	3.1	19.1	4.3
Chicago	10.2	3.0	18.1	4.0
Detroit	11.1	2.4	15.9	3.3
Pittsburgh	8.7	2.9	14.9	4.0
Denver	7.4	4.0	12.4	5.3

††Standardized for age using the total urban population of the United States, 1940. Data collected by the United States Public Health Service.

The common industrial poisons do not affect the general population as a result of atmospheric pollution. In spite of automobiles there seems to be no hazard of carbon monoxide poisoning in the general atmosphere; when cases of illness from toxic substances do occur, usually they result from intimate contact in the home. On rare occasions, mother nature has provided circumstances such as those leading to the episode of Donora and the series of fatalities in the Meuse Valley in Belgium in 1930. Of lesser degree are the episodes of smog with eye irritation in Los Angeles and some similar events in other parts of the country.

Pollution of the atmosphere by fumes and gases of industrial origin may sometimes give rise to a serious situation. From time to time pollution can cause serious annoyance to large groups of people. Where it does not cause direct ill effects, such as irritation of the eyes or upper respiratory system, it frequently does have a considerable nuisance value.

Such nuisances are a detriment to any community and are a challenge to all who are concerned with control measures, either as private individuals or as official governmental agencies.

The amount of disability and mortality from these causes is exceedingly small, so small that it could not be identified in any statistical tabulation of the causes of death or disability. It is not true that the air of our communities contains lethal or disabling amounts of a large variety of toxic substances poured out upon a defenseless community by the neighboring industries.

There should be a considered and intelligent viewpoint in the matter of atmospheric pollution. Not only do fallacious and scarehead pronouncements by irresponsible persons do no good—they may do more harm to the comfort and well-being of communities than the ills they pretend to discuss.

For the most part, the visible agent in atmospheric pollution is smoke which consists mainly of carbon and other combustion products. Smoke may be a very considerable nuisance and is being so recognized. However, smoke pollution has occasioned many loose and injudicious statements.

Smoke Pollution Ills Overrated

Dr. Lanza tells of a memorandum submitted to Mayor William O'Dwyer of New York City. This memorandum dealing with smoke pollution, attempted to substantiate the claim that smoke contributed largely to cancer of the lungs. The memorandum was then submitted to Dr. Louis I. Dublin† who criticized the memorandum writer for misuse of statistics. The preceding table from the Incidence and Prevalence of Cancer of the Lungs by Dorn was omitted from the memorandum, said Dr. Dublin, as were also comments on the table, as follows:

(Dorn): Although exact measures of the air pollution are not available, it is generally thought that, of the cities listed in Table 4, the greatest amount of pollution is in Pittsburgh. However, the incidence rate for lung and respiratory cancer in males is lower in Pittsburgh than in any of the other cities except Denver. There is less difference in the rate of the surveyed cities.

These data do not necessarily prove that atmospheric pollution has no effect upon the incidence of respiratory cancer. On the other hand, they offer no affirmative evidence that such is the case. The causes of respiratory cancer are probably too complicated to be discovered in this relatively crude manner.

Dr. Lanza's own conclusion is: "Atmospheric pollution may or may not be a cause of cancer of the respiratory organs. At the present time our knowledge of the subject is mostly conjectural. We have no authoritative statistics that would indicate an affirmative conclusion."

Some years ago there was considerable discussion as to whether smoke pollution was responsible in part for the mortality from pneumonia. From 1911 to 1913 the Mellon Institute conducted, in Pittsburgh, the first comprehensive study of the smoke problem in this country.

In 1912 Dr. Marcy and Dr. White reported that those districts of Pittsburgh which had the greatest soot fall also had the highest incidence of pneumonia. In 1923 and again in 1929 these observations were confirmed by Dr. Meller. In 1938 Dr. Hagthorn and Dr. Meller published a report (Amer. J. of P.H. April 1938), The Necropsy Evidences on the Relation of Smoky Atmospheres to Pneumonia. They based their report on the post mortem examination of the lungs of 3000 persons who died from various diseases in Pittsburgh hospitals, including women, children and men variously employed in the professions and in industry.

Although this report was made before the advent of chemotherapy robbed pneumonia of most of its terrors, it furnishes information applicable to our problems today. The authors concluded that nothing tangible was found to connect the pigment deposits in the lungs examined with pneumonia incidence or mortality rates.

What may we conclude from the evidence so far available?

1. Industrial fumes and gases do not occur in the general atmosphere to an extent to cause disability or death, except in very unusual and rare instances.
2. Industrial fumes and gases may constitute a nuisance and even at times irritation and inflammation of eyes and upper air passages.
3. As we cannot control the weather, every possible means must be taken to

†Statistician and second vice president, Metropolitan Life Insurance Co., New York, N. Y.

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guard against dangerous or annoying episodes.

4. Smoke pollution, aside from its economic aspects, is a nuisance. It can seriously interfere with general well-being and comfort. That it can cause specific disease or death to any considerable degree cannot be stated in the light of evidence which is now available.

5. That every resource of engineering science and practice should be employed to provide an atmosphere free from annoying or dangerous impurities.

Cooling Towers and Evaporative Condensers*

By S. I. Rottmayer, Chicago, Ill.

Refrigerating condensers designed for use with city water as the vehicle for transporting the heat of the condenser to the sewer are lowest in first cost and simple in operation. Where sewers are inadequate to carry away the condenser water, or where low operating cost is a prime consideration, the heat of the condenser is rejected to the atmosphere rather than to the sewer by the use of evaporative condensers or water cooling towers.

The amount of city water required by these devices to replace losses by evaporation and drift is from 5 to not over 10 percent of that required by city water cooled condensers, and none of this water reaches the sewers.

Water cooling towers are devices in which an intimate contact of warm condenser water with atmospheric air is achieved, thereby promoting an exchange of heat from the water to the air. This exchange is complex, but in effect, part of the water is evaporated into the air, part of the heat of vaporization being supplied by the water, which is cooled in the process.

The extent of cooling is limited by the wet bulb temperature of the air. Hence the efficiency of a device as a water cooler is expressed as a percentage:

$$\text{Percent Eff.} = \frac{\text{(hot water temperature } \textit{minus} \text{ cooled water temperature) X 100}}{\text{hot water temperature } \textit{minus} \text{ wet bulb temperature of incoming air}^{\dagger}}$$

Types of Cooling Towers

The *atmospheric tower,* called also open natural draft, deck type wind tower, is the most common type of tower installed for general refrigerating purposes, considering the number and tonnage of installations.

Mechanical cooling towers may be located within buildings or may be exposed outside. In many instances they are placed outside and are concealed by pleasing architectural treatment. When installed within buildings, mechanical cooling towers may serve as exhaust fans for the ventilating system and may take all or part of the air from inside the building. This air may be cooler and more favorable for service than the outside air.

An ordinary double spray humidifying air washer may be used within a building as a water cooler where considerable area but little head room is available. The high efficiency of counter-flow heat transfer by the vertical mechanical draft tower is not present in this type of apparatus; hence a greater quantity of air must be handled for the same duty.

Disk or propeller type fans generally are used for producing air circulation in mechanical water towers located outside of buildings. Increasing the number of blades of these fans decreases the noise produced. Where particularly quiet operation is essential, housed centrifugal multi-blade blowers usually are employed.

Advantages of mechanical draft cooling towers over atmospheric towers are: independence of natural wind movement, smaller area and weight. Disadvantages are: higher investment, maintenance and operating costs.

The efficiency of a mechanical draft cooling tower ranges between 35 and 90 percent, depending on its design and loading. The usual design has an efficiency of about 67 percent.

Ordinarily it is considered that in atmospheric cooling about one gallon of water per 1000 gal of water circulated per degree of cooling range is lost by evaporation and one gallon of water per 100 gal of water circulated is lost by drift. Thus for a plant in which the water enters the cooling tower at 88 F and departs at 80 F and which circulates 500 gpm the loss will be $\frac{8 \times 500}{1000} = 4$ gpm by evaporation and $\frac{500}{100} = 5$ gpm by drift, a total of 9 gpm.

The water conservation effected by the use of cooling tower equipment over use of city water for condensing generally is taken as 90 to 95 percent.

The evaporative condenser combines an induced draft cooling tower with a refrigerating condenser. It is constructed generally with a single bank of spray nozzles wetting the extended coil surface of a refrigerant condenser built into the air passage. A bank of eliminator plates is interposed between the spray chamber and the leaving air stream. The counterflow principle of heat transfer may be incorporated in this design.

For periods of intermediate temperature during the spring and fall, this apparatus may be operated without water as an air-cooled condenser.

Evaporative condensers are adaptable to service with reciprocating compressors employing ammonia and the fluorine group of refrigerants, and they have been used successfully with the steam jet refrigeration. The original railway car steam jet cooling systems employed evaporative condensers.

Evaporative Condenser Provides High Heat Transfer

An evaporative condenser secures a higher heat transfer rate from

*Abstract of talk given before Illinois Chapter.

†See Heating, Ventilating, Air Conditioning Guide 1949, Chapter 37.

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the refrigerant to the air than is possible with any arrangement using water alone. This is due to exposure to the cooling air not only of the water but also of the surface of the fins on the tubes and the tubes themselves containing the refrigerant. This refrigerant is many degrees warmer than the air and also is several degrees warmer than the water; and due to a greater temperature difference between the donor of the heat and its recipient, the combined heat transfer rate increases measurably.

It follows that the capacity of a given evaporative condenser is increased for an increase in condensing temperature. The amount of this increase, for example, is almost 50 percent when the condensing temperature is elevated from 95 F to 100 F for a selected machine. In other words, the evaporative condenser is a highly efficient heat dissipator and in general should be selected for reasonably high condensing temperatures. The period of operation at the high condensing temperature is usually of short duration, and economical size units can be selected.

The amount of water circulated per ton with an evaporative condenser and common refrigerants normally is ¾ to 1½ gpm per ton, while with a cooling tower, 3 to 4 or 5 gpm per ton are pumped for comparable conditions. The amount of air circulated also is in similar proportion, that with evaporative condensers being about 167—333 cu ft per ton compared with 250—300 cu ft per ton for cooling towers.

THIRD LARGEST PROFESSION STILL GROWING

Jobs in engineering may increase by 100,000 in the next 12 years to a total of nearly a half million, according to a study completed by the U. S. Department of Labor. At present, however, says the Bureau of Labor Statistics, engineering school enrollments are so high that many graduates of the next four years may have to get administrative or sales positions in industry.

Enter Dallas by road, rail or air

Dallas Looks Forward to 56th Annual Meeting

HEADQUARTERS for the 56th Annual Meeting of the Society, January 23-27, 1950, will be the Adolphus and Baker Hotels in Dallas, Tex., C. Rollins Gardner, general chairman of the Committee on Arrangements, announced early this month.

Vice Chairman of the Committee on Arrangements is George A. Linskie, with Dr. F. E. Giesecke, past president, and Reg F. Taylor, member of the council, as honorary chairmen.

Ten committees are already working on meeting plans. Chairmen of these committees are as follows: M. L. Brown—*Banquet;* R. E. Allison—*Entertainment;* Oslin Nation—*Exposition;* E. T. Gessell—*Finance;* T. H. Anspacher—*Ladies;* J. P. Ashcraft—*Publicity;* W. R. Barbeck—*Reception;* P. N. Vinther—*Sessions;* Herman Blum, Jr.—*Special Events;* J. A. Ray—*Transportation.*

For members coming from the north and east, trains will be routed via Cincinnati or Indianapolis and then to St. Louis, Mo., to join the ASHVE special which uses the Frisco and MKT route to Dallas.

The announcements on train schedules, and hotel reservation forms will be mailed soon to all members.

Scheduled Events

The 56th Annual Meeting will include five technical sessions on a variety of heating and ventilating subjects. Throughout the four day program there will be a special events program for the ladies.

Southwest Air Conditioning Exposition

Scene of the Exposition will be the State Fair Grounds where the Hall of Agriculture and the adjoining Poultry Building provide unusually fine facilities. These two modern buildings are readily accessible from downtown Dallas, where the 56th Annual Meeting will be held.

Exhibitors from all parts of the

Buildings which will house the Southwest Air Conditioning Exposition in 1950

country are now working on displays for the exposition which will include every type of appliance capable of use in air conditioning spaces of any required size and adaptable to any stated operating program.

Choice of Dallas as the scene of this, the only exposition of its kind to be held during 1950, was determined by the fact that the locality to which Dallas is a natural gateway is passing through the greatest period of construction activity in its history, and represents the nation's most active sector in the immense construction industry just now, and prospectively for several years to come. An on-the-scene display of heating, ventilating and air conditioning equipment is thus a project of natural appeal.

Round-Trip Rail and One-Way Pullman Fares From Principal Points to Dallas

	1st Class	Coach	Lower	Upper	Roomette	Bedroom	
						1 Person	2 People
Atlanta	$ 51.85	$39.55	$ 7.75	$ 5.90	$10.85	$14.75	$17.05
Baltimore	86.35	63.25	12.60	9.55	17.60	23.95	27.70
Boston	117.31	86.49	15.50	11.80	21.75	29.45	34.10
Buffalo	90.10	63.00	12.25	9.35	17.15	23.30	26.95
Chicago	55.70	42.95	8.90	6.80	12.50	16.90	19.60
Cincinnati	57.25	43.60	8.90	6.80	12.50	16.90	19.60
Cleveland	77.10	54.60	11.15	8.55	15.65	21.20	24.55
Columbus	66.47	50.48	9.50	7.20	13.35	18.05	20.90
Denver	48.60	37.55	7.75	5.90	10.85	14.75	17.05
Des Moines	41.90	32.35	8.65	6.55	12.10	16.45	19.05
Detroit	73.75	51.95	10.65	8.10	14.85	20.25	23.45
Durham, N. C.	76.80	56.45	11.85	9.00	16.60	22.55	26.05
Grand Rapids	70.52	50.65	10.00[a]	7.90[a]	13.60[a]	18.00[a]	20.70[a]
Houston	14.25	11.00	3.50	2.60	4.85	6.65	7.70
Indianapolis	58.45	43.55	8.90	6.80	12.50	16.90	19.60
Kansas City	28.90	22.30	5.70	4.30	7.95	10.85	12.55
Los Angeles	86.45	61.80	13.40	10.20	18.75	25.45	29.50
Memphis	27.30	21.10	5.35	4.10	7.50	10.15	11.75
Milwaukee	59.15	45.65	9.70[b]	7.60[b]	13.30[b]	17.70[b]	21.20[b]
Minneapolis	57.45	44.35	10.05	7.65	14.15	19.10	22.10
Montreal	108.65	80.15	16.65	12.70	—	—	—
New Orleans	30.40	23.90	5.70	4.30	7.95	10.85	12.55
New York	101.17	74.33	14.20	10.80	19.85	27.00	31.25
Norfolk	87.15	62.25	12.60	9.55	17.60	23.95	27.70
Oklahoma City	13.80	10.70	3.50	2.60	4.85	6.65	7.70
Omaha	40.50	31.25	7.20	5.45	10.05	13.70	15.85
Philadelphia	93.97	68.93	13.65	10.35	19.10	25.95	30.05
Pittsburgh	81.00	58.20	11.75	8.95	16.45	22.35	25.85
Portland	118.15	85.00	18.50	14.10	25.95	35.15	40.70
Rochester	94.40	66.15	12.60	9.55	17.60	23.95	27.70
St. Louis	38.95	30.05	7.20	5.45	10.05	13.70	15.85
Salt Lake City	74.70	57.70	12.60	9.55	17.60	23.95	27.70
San Antonio	16.90	13.05	3.50	2.60	4.85	6.65	7.70
San Francisco	95.70	68.05	15.25	11.60	21.30	29.00	33.55
Seattle	118.15	85.00	18.50	14.10	25.95	35.15	40.70
Shreveport	11.25	8.75	1.35[c]	—	—	—	—
Syracuse	99.60	69.80	13.65	10.35	19.10	25.95	30.05
Toronto	87.95	63.70	13.95	10.65	19.65	26.50	30.10
Tulsa	17.15	13.25	3.50	2.60	4.85	6.65	7.70
Washington, D.C.	86.35	63.25	12.60	9.55	17.60	23.95	27.70
Winnipeg	69.75	55.85	14.15	10.75	—	26.90	31.10

[a]Seat Grand Rapids to Chicago
[b]Seat Milwaukee to Chicago
[c]Seat Rate
The above rates do not include 15 percent U. S. Government tax.
The fares and schedules shown are those in effect July 15, 1949 and are subject to change.

Honored by Life Membership

Frank B. Rowley
Minneapolis, Minn.

FRANK B. ROWLEY

—Professor & head of mechanical engineering department and director of Engineering Experiment Station, University of Minnesota, Minneapolis.
—President ASHVE 1932, 1st Vice Pres. 1931; 2nd Vice Pres. and Chairman, Committee on Research 1930; Council 1927-33. Pres. Minn. Chapter 1922.
—Author of many technical papers; received F. Paul Anderson Medal, 1939.
—Member *ASME; ASRE; American Society for Engineering Education; NSPE.* Fellow, *American Association for the Advancement of Science.* Member, Minnesota technical societies.
—Consulting engr.; registered professional engr., Minnesota.

WALTER E. GILLHAM

—Consulting engineer, since 1910, designing power plants, heating and ventilation for large buildings in vicinity of Kansas City, Mo.
—Learned the art of heating and ventilating school buildings with chief engineer's office, Kansas City Board of Education and with Lewis & Kitchen, Kansas City.
—Helped organize Kansas City Chapter, ASHVE, in 1916; past president of the Chapter. During his presidency, Kansas City Chapter was host to Society for Semi-Annual Meeting, 1924.
—Member of ASHVE Council, 1924-26; treasurer of Society, 1926-29.

Walter E. Gillham
Kansas City, Mo.

Harry H. Angus
Toronto, Canada

HARRY H. ANGUS

—Consulting engineer. Heads the firm of H. H. Angus & Associates, Toronto.
—Formerly draftsman and designer with Ingersoll Rand, Quebec, Westinghouse Machine Co., Pittsburgh, Bethlehem Steel Co., Bethlehem, Pa., and Western Electric Co., Chicago.
—Helped organize Ontario Chapter, ASHVE; past president of Ontario Chapter; Member of Society's Council 1927-29.
—Graduate of University of Toronto, mechanical engineering.

ROY D. TYLER

—Training officer, Veterans Administration, U.S.P.O., Boston, Mass.
—Other experience: topographer, location engineer and construction engineer for various railroads; structural engineer in Illinois; design and sale of heating equipment with Modine Mfg. Co., Racine, Wis.
—Licensed professional engineer, New York State, Minnesota.
—Life Member, *American Society of Civil Engineers;* Chapter 46, New York City. Spanish-American War Veterans.

Roy D. Tyler
Boston, Mass.

Louis T. Braun
Chicago, Ill.

LOUIS T. BRAUN

—Executive secretary, *Heating, Piping and Air Conditioning Contractors Chicago Association* (formerly *Chicago Master Steamfitters Association*) since 1916.
—Earlier experience: draftsman; superintendent of construction in large industrial company; later, office manager, architectural firm.
—Born in Cincinnati, Ohio, educated in Cincinnati and Upper Canada College, Toronto.

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Honored by Life Membership

WILLARD F. UHL

—Partner, The Uhl Co., Minneapolis, Minnesota manufacturers' agent for heating apparatus.
—Formerly manager, Minneapolis branch, C. A. Dunham Co.
—Apprenticeship with Westinghouse Electric and Manufacturing Co., Pittsburgh; Canadian Westinghouse, Winnipeg, Manitoba; Northern Electric Co., Imperial Wire and Cable Co.
—Board of Governors, secretary, vice president and president of Minnesota Chapter, ASHVE, 1928-33.
—Graduate of Iowa State College, Ames, Ia., with E. E. degree.

Willard F. Uhl
Minneapolis, Minn.

John B. Coleman
Providence, R. I.

JOHN B. COLEMAN

—Chief Engineer, Grinnell Corp., Providence, R. I., since 1921.
—Before 1921, was general manager, Gordon Dryer Corp., Providence.
—U. S. Army: two years as construction officer in Army and coast artillery posts.
—Began in 1901 with the firm which is now Grinnell Corp., worked successively as draftsman, engineer, chief engineer, engineering and construction superintendent, and sales engineer.

S. E. FENSTERMAKER, SR.

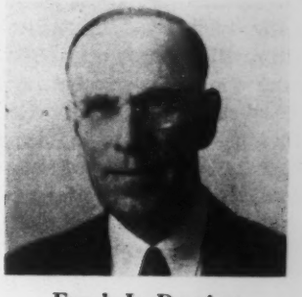
—Conducts sales engineering business with Charles Hagedon under the name of S. E. Fenstermaker & Co., Indianapolis, having branch offices in Louisville, Ky. and Chattanooga, Tenn.
—Formerly chief engineer, western division of Warren Webster & Co.
—Has prepared plans and specifications for mechanical equipment of many large projects.
—Graduated from Iowa State College, Ames, Iowa.
—Past president and treasurer of Construction League, Indianapolis, now on Board of Directors. Member of *ASME, Air Conditioning Council.*

S. E. Fenstermaker
Indianapolis, Ind.

Albert A. Criqui
Buffalo, N. Y.

ALBERT A. CRIQUI

—Associated with Buffalo Forge Co., Buffalo, N. Y., for 46 years. Chief engineer from 1915 to 1948; consulting engineer since 1948.
—Obtained several early high speed fan patents. Developed centrifugal and static air cleaning devices and modern ship ventilation fans.
—Received *Modern Pioneer Award* in American Industry in 1940, presented by the *National Association of Manufacturers.*
—Licensed professional engineer in New York State.



Frank L. Doering
Lynchburg, Va.

FRANK L. DOERING

—Engineer 37 years with American Radiator & Standard Sanitary Corp., Lynchburg, Va.; design, development of heating equipment.
—World War I service in War Dept., Office of Construction Division, Heating and Plumbing Section.
—Educated in Ohio public schools and New York technical school.

UNIVERSITY OF MICHIGAN LIBRARIES

Minneapolis Postscripts

GOLFERS DEFY RAIN FOR TOURNAMENT

Reported by Bruce McLouth

Following an excellent buffet luncheon capped with quantities of fresh strawberries, 25 members and 15 guests teed off in beautiful weather to begin the ASHVE Annual Golf Tournament at the Minneapolis Golf Club Monday afternoon, June 20.

As the last foursome approached the 9th green, a downpour chased the players to cover. When the rain let up, all but a single foursome returned to the fairways to finish the game. The weather certainly dampened the spirits as well as the bodies of the players, but a couple over par on the 19th hole seemed to rectify any with low morale or chilled heart.

Without question, those who played the fewest holes in the rain came out best in the long run, but such is the good game of golf.

Presentation of the "Cups" and other awards was delayed till the night of the banquet. The Research Cup was ably presented to the winner, R. H. Lee, of the Minnesota Chapter, by John James, vice chairman of the Committee on Research. Merrill Blankin, past president of the ASHVE and member of the Philadelphia Chapter, made an equally impressive presentation of the Eichberg Memorial Cup to R. C. Jordan, president of the Minnesota Chapter, for the team which won the cup.

A new trophy was added by the Minnesota Chapter and was awarded to the winner at the same time. This cup will be known as the "Paul Bunyan" Cup and is to be annually presented to the player with the largest score or in golfer's language, "high gross". It is the intent of the Minnesota Chapter to reward honesty even in golf scores. Surely, Paul Bunyan himself, who played golf with clubs having telegraph poles for shafts and using a "Medicine ball" for the golf ball, would want the award made to the player with the biggest score.

Bob DeHaven, well known radio announcer and toastmaster for the evening, made some very fitting remarks in presenting the new cup to William H. Old of the Michigan Chapter. It might be of interest to know that the new cup is of stainless steel body 7½ inches in diameter and 11½ inches high. Two stately handles made of hand hammered ⅝ inch OD copper tubing add grace to the body which comfortably rests on a slightly used auto hub cap, also of stainless steel. A wood base provides the final resting place of the cup, and this base is said to be made from the original whiffletree used by "Babe," the Blue Ox owned by Paul Bunyan.

Following is a list of the winners of the golf tournament:

Research Cup (Low Net)—Winner, Robert H. Lee, (Minnesota Chapter): Gross 81, Handicap 12, Net 69.

Eichberg Memorial Cup—Three Man Team Play. Winner, Minnesota Chapter: J. G. Hamm, Gross 83, Handicap 6, Net 77; J. K. Gerrish, 88, 9, 79; R. H. Lee, 81, 12, 69. Total 225. Runner-up—Illinois Chapter—J. S. Kearney, Net 77; R. E. Moore, 78; M. W. Bishop, 73. Total 228. Third Place—Northern Ohio Chapter. Lester T. Avery, Net 80; W. R. Moore, 79; R. L. Byers, 88. Total 247.

Paul Bunyan Cup (High Gross)—Winner, W. H. Old, Michigan Chapter, Gross 122.

Blind Bogey—Lester T. Avery, Northern Ohio; William Sturm, Minnesota; W. R. Moore, Northern Ohio; N. D. Adams, Minnesota; J. K. Gerrish, Minnesota; R. Edwin Moore, Illinois; L. W. Bren, Minnesota.

Most Pars: John G. Hamm, Minnesota; *Most 6's,* E. Floyd Bell, Minnesota; *Most 7's,* B. F. McLouth, Minnesota; *Most 8's,* P. B. Gordon, New York; *Most 9's,* R. L. Byers, Northern Ohio.

TOURS—INSPECTIONS

University Tour

At the University of Minnesota, a score of members and guests took time out from the Semi-Annual Meeting sessions to make a tour of the University's physics and engineering departments. Mechanical devices demonstrating principles of physics were shown to the inspection group.

Bros Boiler Co.

Visitors at the Bros Boiler Co. plant saw workmen roll heavy steel plates, some more than one inch thick, for the forming of shells for pressure vessels. They also witnessed the forming of heads of this same heavy metal.

Production methods of fabricating low pressure heating boilers were viewed, as were also some of the latest methods of tube bending and of automatic welding on tanks of various types.

General Mills' Betty Crocker Kitchen

On Tuesday, 70 ladies of the ASHVE made a tour of the General Mills Plant and the "Betty Crocker Kitchen." The ladies were shown through the spic and span kitchen, where a baking demonstration was conducted and refreshments were served.

Nearly 30 members and guests also toured the vast General Mills plants in Minneapolis.

Minneapolis-Honeywell

The downtown plant of the Minneapolis-Honeywell Regulator Co. was visited by 44 members and guests, who saw the assembly of many of the control instruments which were coming off the assembly line as the visitors entered. Also shown was the cold room where temperature sensitive elements are calibrated.

Summary of Chapter Meetings*

• CINCINNATI—May 26, 1949. At the dinner meeting held in the Summit Hills Country Club, Ft. Mitchell, Ky., the following officers were elected for the coming year: *President*—K. B. Little; *Vice President*—E. W. McNamee; *Secretary-Treasurer*—D. J. Wood; *Board of Governors*—C. D. Weaver, Jr.

M. J. Gibbons was presented with a certificate of Life Membership by H. E. Sproull. Mr. Gibbons voiced his pleasure on being elected to Life Membership and reminisced about the early years of the Society and the heating industry.

Reports were made by chairmen of the following committees: J. J. Bechtol, auditing; Mr. Weaver, program; Mr. Little, finance; and A. H. Gerdsen, entertainment. A past president's pin was presented to retiring president M. E. Mathewson by Mr. Little. W. J. Killian was named program chairman for the new year. F. W. Wilson was appointed chairman of the membership committee and O. E. Rapp became chairman of the entertainment committee.

Prior to the meeting, members and guests enjoyed an afternoon of golf and baseball. Attendance 64.

• MANITOBA—May 23, 1949. The May meeting, following golf and dinner at the Elmhurst Golf Club, was the occasion of the Ladies' Annual Spring Party. Short talks were made by William McNeil and Mrs. P. L. Charles.

J. R. Stephenson made an address relinquishing the presidency in favor of his successor, A. W. Moss. Other new officers were introduced to the group as follows: *Vice President*—D. F. Michie; *Secretary-Treasurer*—C. M. Fleming; *Governors*—J. A. Bell, J. F. Bertram, A. K. Piercy, E. H. Price and Mr. Stephenson.

Following the meeting, members and guests spent the evening dancing in the clubhouse. Attendance 32.

• NORTH CAROLINA—June 24, 1949. The summer meeting was held during the week-end at Greystone Inn in Roaring Gap, N. C.

The meeting was called to order Friday night, June 24, by Pres. DeParx Stimson and after a very brief business session, the meeting was turned over to R. B. Crosland, Jr., chairman of program committee.

Saturday was devoted to golf and bridge, followed by the banquet and dance Saturday night. The members and guests were treated to a buffet luncheon before departure Sunday afternoon. Attendance 62.

• NORTH TEXAS—June 20, 1949. Four guest speakers took part in a panel discussion during the meeting held in Dallas. J. S. Hopper acted as moderator, referred various questions to the speakers; Peter Naugle, Herbert Tatum, C. L. Kribs, Jr., and M. L. Brown.

J. A. Roy was in charge of the program. A business meeting followed the panel discussion, and various committees reported on their activities. Attendance 87. Attendance ratio 0.47.

• OREGON—May 5, 1949. The heat pump installation is only as good as controls can make it, J. Donald Kroeker told the Chapter at the dinner meeting held in Portland. Mr. Kroeker described results after a year of operation of the large heat pump installation in the Equitable Building, Portland.

Pres. John P. McDermott reported that W. B. Morrison is the delegate to the Oregon Technical Council, with J. A. Freeman as alternate. K. N. Flocke reported on the Oregon State College Conference held last March, and Mr. Kroeker reported on the Southwestern Air Conditioning Conference. Attendance 103. Attendance ratio 0.46.

• SOUTH TEXAS—July 23, 1949. An informal meeting was held at the residence of R. H. Wittbold, Houston. A fine barbecue plate and other refreshments were served to the 25 persons in attendance.

A lively bridge game and Mr. Wittbold's television set kept some of the members occupied during most of the evening. Pres. R. J. Salinger provoked an animated discussion by inviting two of the members, who are contractors, to offer constructive criticism of the methods used by the engineer in presenting plans and specifications for bidding. Several manufacturers' representatives and engineering salesmen were drawn into the discussion.

In spite of the several different viewpoints brought out, the meeting broke up on a note of good fellowship, the members and guests departing about 10 p.m. Attendance 25. Attendance ratio 0.12.

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

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• **SOUTH TEXAS**—June 27, 1949. No regular business was discussed as members held the annual summer get-together at Saengerbund Hall, Houston. Members and their ladies spent the evening in square and ballroom dancing. Refreshments were available for all. Master of ceremonies for the get-together was Chapter President R. J. Salinger. Attendance 20. Attendance ratio 0.12.

• **WASHINGTON, D. C.**—May 19, 1949. The final meeting of the year 1948-49 was a social one, the annual Ladies' night, held in the Terrace Room of the National Airport. The dinner-dance was sponsored jointly by the Engineers Club of Washington and sections of several national engineering societies. Attendance 152. Attendance ratio 0.37.

ASRE Executives
Standing L. to R. **Edward Simons, Vice President, J. G. Bergdoll, Jr., Vice President, Paul B. Christensen, Treasurer, Miss Martha Flaherty, Assistant to Treasurer.** ***Seated:*** **M. C. Turpin, (left) Secretary and Burgess H. Jennings, President**

Student Branch

▲ **UNIVERSITY OF DETROIT**—May 3, 1949. The following were elected to hold office for the coming year: *President*—L. M. Blanchette; *Vice President*—Arthur F. Lewis; *Secretary - Treasurer* — S. H. Kosinski; *Reporter*—R. E. Seaton.

Guest speaker was R. Doremus, of the Detroit Ice Co., who spoke on *Refrigeration and Its Practical Applications.* The speaker was introduced by Joseph Olivieri, chairman. Attendance 28. Attendance ratio 0.42.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 50 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by September 24, 1949, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

BELL, C. W. A., Assoc. Mech. Engr., Oak Ridge National Laboratory, Oak Ridge, Tenn. PROPOSERS: J. F. Turner, C. A. Spears, Jr. SECONDERS: A. G. May, R. N. Mason*.

BIRNIE, G. H., Owner, George H. Birnie, Victoria, B. C., Canada. PROPOSERS: M. E. Minaker, D. W. Thomson. SECONDERS: W. H. Evans, J. H. Fox.

BOWERS, J. W., Br. Engr.-Sales Engr., Minneapolis-Honeywell Regulator Co., Grand Rapids, Mich. PROPOSERS: L. A. Calcaterra, W. W. Bradfield. SECONDERS: R. B. Smith, M. A. Lett.

BOYER, A. M., JR., Vice Pres., Secy. & Engr., Marks Heating & Air Conditioning Co., Augusta, Ga. PROPOSERS: Leo Sudderth, Jr., W. M. Garrard. SECONDERS: W. S. Hunken, H. S. Reil*.

BROWN, T. C., Assoc. Prof., North Caro-

*Non-member

lina State College, Raleigh, N. C. PROPOSERS: L. L. Vaughan, R. B. Rice. SECONDERS: F. J. Reed, R. S. Wilbur*.

CLEMENS, J. K., Res. & Test. Engr., Crane Co., Chicago, Ill. PROPOSERS: J. D. Pierce, M. W. McRae. SECONDERS: E. M. Peterson, C. J. Stermer.

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CORNELLIER, J. C. A., Plbg. & Htg. Sales Mgr., A. Prud'Homme & Fils Ltée, Montreal, Que., Canada. PROPOSERS: Gerard Martin, Leo Garneau. SECONDERS: T. H. Worthington, F. A. Hamlet.

DE VRIES, T. E., Engr., Messrs. Arthur Scull & Son, Ltd., Port of Spain, Trinidad, B. W. I. PROPOSERS: John Carmichael*, W. A. Kaufman*. SECONDERS: Jack Walrihoun*, A. E. Smith*.

DEXTER, H. E., Engr., James H. Merritt & Co., New York, N. Y. PROPOSERS: R. H. Seibert, F. D. Lawrence. SECONDERS: J. P. Soule, T. A. Smeltz*.

DRESKIN, STANLEY, Htg. & Vent. Des. Engr., Kellex Corp., New York, N. Y. PROPOSERS: L. J. Steilen, S. J. Klion. SECONDERS: W. H. O'Connell, N. H. Weiss*.

FAINSTAT, M. M., Lecturer, McGill University, Montreal, Que., Canada. PROPOSERS: J. R. Dupuis, W. W. Timmins. SECONDERS: C. A. Robbs*, E. W. Twizell.

FLAKE, R. A. J., Draftsman-Sales, Warden King, Ltd., Toronto, Ont., Canada. PROPOSERS: Thomas Ferguson, J. A. Norton. SECONDERS: R. A. Leith, E. J. LeFebvre.

GAFFNEY, L. F., Asst. to Engr., Edward E. Ashley, Cons. Engr., Washington, D. C. PROPOSERS: E. E. Ashley, S. A. Spencer. SECONDERS: H. R. Iverson, W. C. Jones.

HANEY, E. P., Vice Pres., Catlett Engineers, Inc., Dallas, Tex. PROPOSERS: J. P. Ashcraft, W. A. Catlett. SECONDERS: W. F. Kaun, W. H. Kuhn.

HICKS, D. B., Engr., Danforth Co., Pittsburgh, Pa. PROPOSERS: J. N. Riley, N. W. Raine. SECONDERS: F. C. McIntosh, E. C. Hach.

HOLZER, E. J., Sales Engr., C. Emery Nelson, Inc., Minneapolis, Minn. PROPOSERS: O. L. Lilja, B. F. McLouth. SECONDERS: P. D. Robinson, R. L. Michaud.

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ISAAC, F. P., Design & Installation, Frank Isaac Plumbing & Heating Co., Warrensburg, Mo. PROPOSERS: C. D. Jones, W. A. Reichow. SECONDERS: E. E. Ralston, Henry Nottberg, Jr.

JAMISON, R. F., Sales Engr., Commercial Div., Minneapolis - Honeywell Regulator Co., Wichita, Kans. PROPOSERS: W. F. Ryan, E. C. Blood. SECONDERS: L. H. Johnson, Jr.*, R. F. Perkins*.

KANE, W. G., Vice Pres. in charge of sales & service, Lewis Associates, Inc., Port Washington, N. Y. PROPOSERS: R. U. Berry, Ernst Graber. SECONDERS: C. S. Koehler, O. F. Quist, Jr.

KIRKWOOD, A. G., Sales Engr., Walter Cooke, Mfrs. Agent, New Orleans, La. PROPOSERS: Walter Cooke, Ralph Elizardi. SECONDERS: H. Luehrmann*, W. H. Grant, Jr.

KLAPPER, G. E., Mech. Engr., Philadelphia Electric Co., Phila., Pa. PROPOSERS: H. H. Mather, W. P. Culbert. SECONDERS: E. K. Wagner, R. F. Hunger.

LAMB, D. A., Jr. Partner, Lamb Engineering Co., Baltimore, Md. PROPOSERS: E. L. Crosby, H. D. Glaser. SECONDERS: E. J. Morris, E. R. Kent.

LASS, F. P., Sales Engr., Raytheon Mfg. Co., Chicago, Ill. PROPOSERS: R. V. Mehaffey, C. R. Kuglin. SECONDERS: A. L. Crump, N. E. Bueter.

LAWRENCE, B. G. H., Lecturer in Htg. & Vent., National College for Heating & Ventilating, Refrigerating & Fan Engineering, London, England. PROPOSERS: D. Ingell*, G. F. M. Murray*. SECONDERS: Hugh Bell*, R. H. Young*.

LINCK, G. F., Mech. Engr., Riggs Distler & Co., Inc., Baltimore, Md. PROPOSERS: E. J. Morris, A. M. K. Kroft. SECONDERS: E. L. Crosby, R. E. Dressell.

LINDBERG, I. A., Sales, Walter Cooke, New Orleans, La. PROPOSERS: Walter Cooke, Ralph Elizardi. SECONDERS: H. Luehrmann, W. H. Grant, Jr.

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TEMPLEMAN, CAPEL, Sales Supervisor, Iron Fireman Mfg. Co. of Canada, Ltd., Toronto, Ont., Canada. PROPOSERS: Robert Dunn, J. H. Ross. SECONDERS: V. J. Jenkinson, G. P. Cooper.

TIMANUS, W. R., Timanus & Associates, Cons. Engrs., Baltimore, Md. PROPOSERS: E. L. Crosby, H. D. Glaser. SECONDERS: G. B. Priester, E. H. Taze.

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VAN WERT, P. H., Mech. & Structural Engr., Macklin & Stinson, Archts. & Engrs., Winston-Salem, N. C. PROPOSERS: C. E. McCallum, C. Z. Adams. SECONDERS: R. K. Hunter, R. W. Allen.

Students

The following candidates are students from the colleges and universities listed as follows:

McGill University, Montreal, P.Q., Canada. PROPOSERS: Robert Clapperton, W. S. Murray. SECONDERS: Leo Garneau, S. W. Salter.

UTLEY, P. A.

Pennsylvania State College, State College, Pa. PROPOSERS: David Lifton, E. R. Queer. SECONDERS: J. L. Dilworth*, A. H. Zerban*.

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RINDOSH, J. L.

Purdue University, W. Lafayette, Ind. PROPOSERS: W. T. Miller, C. W. Sallman. SECONDERS: W. L. Kixmiller,

*Non-member

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MILLER, J. C.

University of Texas, Austin, Tex. PROPOSERS: W. E. Long, Karl Martino. SECONDERS: D. P. Collins, A. G. Allen.

GAMBRELL, J. B., JR.
MARWILL, G. G.
OPPENHEIM, T. N.
SUCKE, R. W.

University of Wisconsin, Madison, Wis. PROPOSERS: Prof. D. W. Nelson, G. L. Larson. SECONDERS: Prof. L. A. Wilson*, R. A. Rose*.

ADLER, H. C.

*Non-member

Advancements

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HOLLADY, W. L., Vice Pres. & Chief Engr., Hieatt Engineering Co., Los Angeles, Calif. PROPOSERS: Leo Hungerford, A. J. Hess. SECONDERS: R. S. Farr, C. W. Pollock.

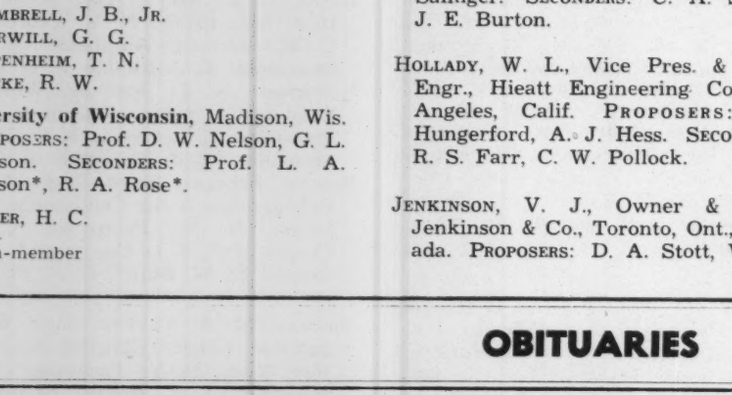
JENKINSON, V. J., Owner & Mgr., Jenkinson & Co., Toronto, Ont., Canada. PROPOSERS: D. A. Stott, W. W. Miller. SECONDERS: C. J. Bootes, J. H. Fox.

MCAKERNAN, G. S., Secy., Treas. & Supt., Reg. H. Steen, Ltd., Toronto, Ont., Canada. PROPOSERS: E. G. Spall, Ernest Fox. SECONDERS: J. W. Darling, V. J. Jenkinson.

TRELEAVEN, H. M., Sales Mgr., Trane Co. of Canada, Ltd., Toronto, Ont., Canada. PROPOSERS: S. A. Jennings, S. L. V. Fisher. SECONDERS: J. L. Neilans, Ralph Ramsey.

WODAL, J. J., Mech. Engr., The Austin Co., Los Angeles, Calif. PROPOSERS: C. F. Metzler, J. F. Park. SECONDERS: I. E. Mayne, R. A. Lowe.

OBITUARIES



William T. Hopson

WILLIAM T. HOPSON

William T. Hopson, Life Member of the Society, died on July 17 after a brief illness. He was 84 years old.

Mr. Hopson was president of the Hopson and Chapin Co., New London, Conn. Since 1914 he had been a heating engineer and contractor. The business with which he had been affiliated for so long formerly was known as Hopson & Chapin Mfg. Co. Foundry & Machine Works.

Mr. Hopson was born March 31, 1865 in Kent, Conn., and attended schools in Kent, Great Barrington, Mass., and Bridgeport. He was graduated from Williston Academy in 1883.

He entered the heating and ventilating field as an apprentice in 1883, and learned drafting in the foundry and machine shop. Mr. Hopson had been president of the firm since 1914. He was well-known throughout the east as an engineer, and locally had been prominent in community affairs, serving as president of the board of trustees of Chapman Technical High School for 32 years. He was a member of the board of managers of Lawrence Memorial Hospital and also of the board of directors of the Savings Bank of New London.

Mr. Hopson had been a Society member since 1915 and a Life Member since 1935.

J. HERBERT BEKESHUS

J. Herbert Bekeshus, 44, Troy, N. Y., died on July 5, 1949 in St. Vincent's Hospital, New York City.

Mr. Bekeshus was born on May 2, 1905 in Alexander, Kansas and was educated in Missouri and Wisconsin public schools. He studied electrical engineering at Rice Institute, Houston, Tex., and in 1925 entered the heating and ventilating field in Troy, N. Y.

In 1938 he organized Pioneer Oil Heat, Inc., but took a leave of absence to do war work from 1942 to 1945 with York-Shipley, Inc., York, Pa., where he was research and development engineer. He returned to Pioneer Oil Heat, Inc., in 1945, and at the time of his death was president of the firm.

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Two Years: DeWitt M. Allen, F. Aylmer Hamlet, Charles S. Leopold, Howard E. Sproull.

One Year: M. W. Bishop, Carl F. Boester, Leo Hungerford, Reg F. Taylor, George L. Tuve, L. N. Hunter, *Ex-Officio.*

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Finance: Lauren E. Seeley, *Chairman;* Leo Hungerford, H. E. Sproull, Ernest Szekely, *Ex-Officio.*

Membership: M. W. Bishop, *Chairman;* D. M. Allen, F. A. Hamlet.

Program and Papers: R. F. Taylor, *Chairman;* F. A. Hamlet, C. O. Mackey.

Standards: Carl F. Boester, *Chairman;* Spencer W. Boyd, J. Donald Kroeker.

ADVISORY BOARD

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SPECIAL COMMITTEES

Admission and Advancement: T. F. Rockwell, *Chairman (one year);* L. S. Ries *(two years);* G. D. Winans *(three years).*

Chapter Delegates: A. W. Edwards, *Chairman;* B. L. Evans, *Vice Chairman;* Fred Janssen, *Secretary.* Delegates and alternates of local chapters are respectively as follows:

ATLANTA: R. L. Beach—Leo Sudderth, Jr.
CENTRAL NEW YORK: V. S. Day—D. L. Mills
CENTRAL OHIO: W. M. Myler, Jr.—E. A. Norman, Jr.
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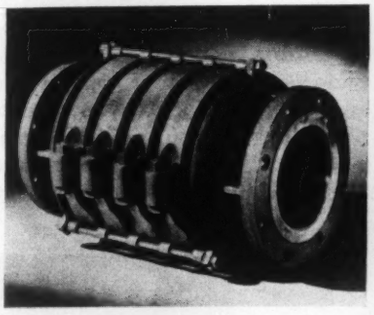

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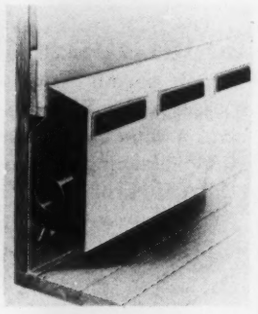

Baseboard Cover

Streamlines Front Cover for Baseboard Radiation

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It is a front outlet type with 3½ in. x 1 in. embossed slots just below the top front edge. The solid portion is said to completely hide the core and to give off ample radiant heat for floor level comfort.

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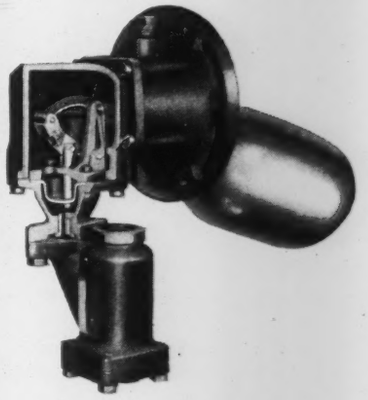
New Corrosion Resistant Sheet and Plate Give Better Protection

No. 4130—"Durimet 20" is a new analysis, special low carbon, austenitic stainless steel alloyed so that its corrosion resistance is said to be superior to that of conventional 18-8 stainless, and yet to retain approximately the same working characteristics. It is available in sheets and plate from Duriron Co., Inc., 450 N. Findlay St., Dayton 1, Ohio.

It is particularly recommended for laboratory fume ducts, hoods, table tops, troughs, battery room ducts, etc. According to the company, there is probably no corrosive condition in any general laboratory where this material does not provide adequate protection. It is said to be resistant to much more severe corrosive conditions than any sheet formerly produced by the company.

Feeds Makeup Water to Boiler



No. 4131—The No. 21 and No. 121 make-up water feeders have been developed by McDonnell & Miller, Inc., Wrigley Bldg., Chicago 11, especially for use on receiving tanks of boiler return systems.

Outstanding features are said to include straight thrust, cam and roller valve action, designed to provide tight closure against water supply pressures up to 150 psi, a stainless steel valve and seat, and a large integral strainer flange mounted for easy cleaning. According to the company, the primary use of the device will be in combination with the firm's condensation pump control, a float switch located on the boiler for starting and stopping the condensation pump so as to maintain proper boiler water level.

Refrigeration Capacity Control Cuts Out Two of Four Cylinders

No. 4132—Twenty-three refrigerating compressors produced by Frigidaire Div., General Motors Corp., Dayton 1, are equipped with new "step-control" devices, designed

FOR YOUR CONVENIENCE

Heating, Piping & Air Conditioning [9-49]
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each number in which you are interested)

4128	4129	4130	4131	4132	4133	4134	4135	4136	4137
4138	4139	4140	4141	4142	4143	4144	4145	4146	4147
4148	4149	4150	4151	4152	4153	4154	4155		
7388	7389	7390	7391	7392	7393	7394	7395	7396	7397
7398	7399	7400	7401	7402	7403	7404	7405	7406	7407
7408	7409	7410	7411	7412	7413	7414	7415	7416	7417
7418	7419	7420	7421	7422	7423	7424	7425	7426	

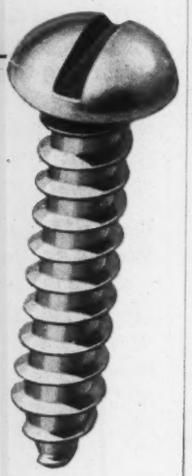
Name..... **Title**.....

Company .....

Address .....

City..... **Zone**..... **State**.....

ELCO



THESE SCREWS
Answer IMPORTANT QUESTIONS
ABOUT WHICH *Fasteners* TO USE

Uniformity?

Elco heads, threads, slots are made consistently alike under a system of rigid production control. This is assurance against defects and costly delays.

Fast Assembly?

Quick, easy-starting points with accurately formed heads, threads and slots qualify Elco Fasteners for mechanical pick-up and driving. Hours of handling time are saved.

Tensile Strength?

Elco fasteners hold securely in place, continuously under maximum tension, because they are made from special analyzed steels, selected by experience and maintained from constant sources.

Customer Satisfaction?

The dependability of Elco fasteners to provide uniformity, fast assembly and maximum tensile strength means a superior product and trouble-free assembly operation.

Write today and inquire about Elco fasteners to meet your assembly requirements. Send for catalog No. 48.

ELCO Screws

ELCO TOOL AND SCREW CORPORATION
1920 BROADWAY ROCKFORD, ILLINOIS
WOOD SCREWS • MACHINE SCREWS • MACHINE SCREW NUTS
DRIVE SCREWS • CAP SCREWS • LAG SCREWS • SPECIAL SCREWS
TAPPING SCREWS • STOVE BOLTS • PIPE PLUGS

to reduce operating costs and afford increased efficiency for large air conditioning systems.

By automatically cutting out two of four cylinders, the new controller is designed to reduce the refrigerating capacity of compressors when equipment is operating under a partial load. The new device is installed on 7½, 10, 15, and 20 hp reciprocating compressors for use with city water, water tower, and evaporative condenser type cooling systems. According to the company, capacity can be reduced 50 percent for 7½ and 10 hp compressors, 33⅓ percent for 15 hp units, and from 25 to 50 percent for 20 hp models.

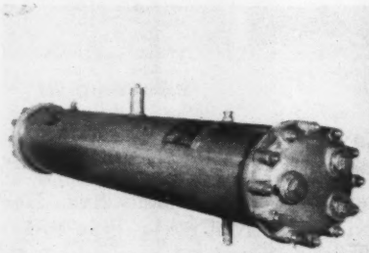
Along with saving in electrical power consumption, another advantage of the device, when operated with evaporative suction pressure regulating valves, is said to be the prevention of moisture freezing on the cooling coils.

Straight Through Tube Construction Used in "Freon" Condensers

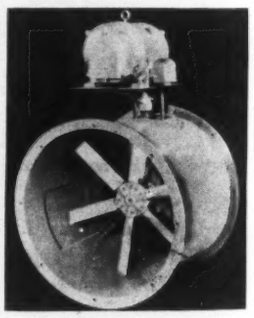
No. 4133—Acme Industries, Inc., Jackson, Mich., has included latest features in its line of shell and tube type "Freon" condensers.

Units incorporate fixed tube sheets with tube holes serrated and tubes roller expanded into position, straight through tube construction for simplified cleaning, shells of heavy wall stainless steel tubing designed for working pressure of 100 psi on the water side and 235 psi on the refrigerant side, and the "all-in-one" tube which has integral fins.

The STF series, available in a range of capacities up to approximately 230 tons, features combination type heads which permit water connections for either four or two passes. The SRF series units have flanged water heads and a removable cover plate on the front head to permit tube cleaning without removal of water connections. Capacities of these models range up to approximately 550 tons.



Refrigeration Condenser



Axial Fan

Axial Fans Designed for Heavy Duty Service

No. 4134—An improved line of axial fans, offered by Chicago Blower Corp., 4558 W. Congress St., Chicago 24, is available in sizes from 14 to 48 in. According to the company, units have been designed for heavy duty applications in cooling, exhausting, drying, etc.

Blades are of the adjustable pitch type and are of airfoil design. Blades and hubs are of separate aluminum alloy castings, machined and matched. All motors directly in the air stream are fully enclosed and of the ball bearing type. Motors out of the air stream are of the ball bearing, open type. Explosionproof and high ambient temperature motors are available for special applications as are various coatings. All fans are nonoverloading.

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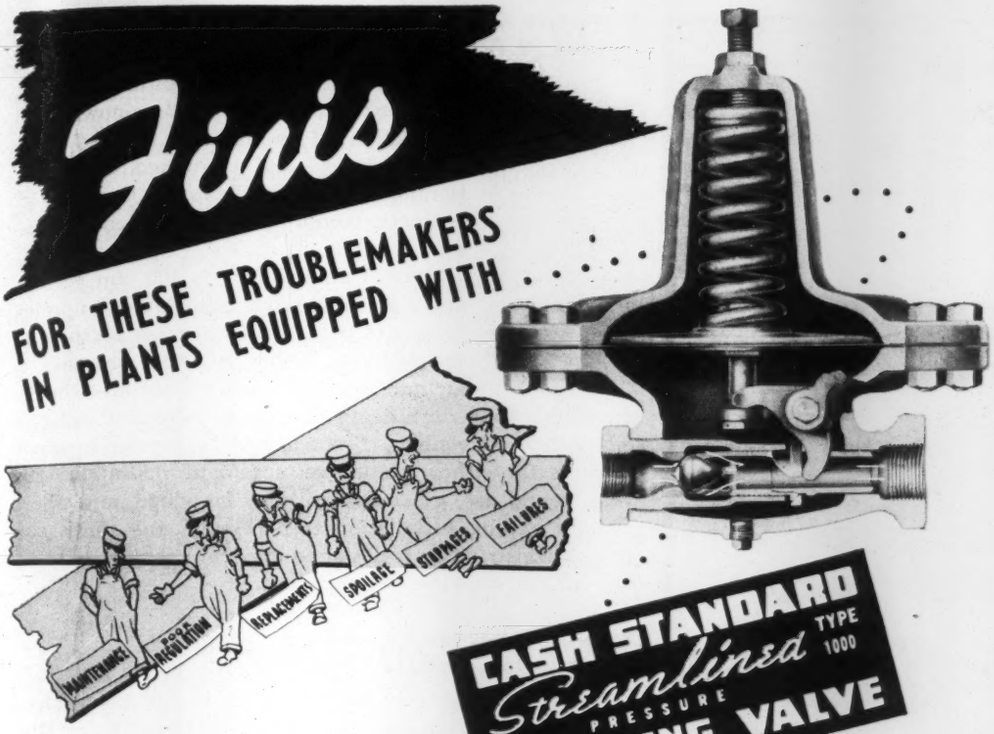
Finis

FOR THESE TROUBLEMAKERS IN PLANTS EQUIPPED WITH



CASH STANDARD *Streamlined* PRESSURE **REDUCING VALVE** TYPE 1000

Here's why

IN THE USERS OWN WORDS . . . . .

(Note how users' statements check against the 10 benefit points listed below)

FROM A TIRE COMPANY

"We installed your '1000' reducing valve in our re-capping set-up about six years ago and to this date we have had **trouble-free** service. Periodically I check steam **pressure** and find it to be very **accurate.** I wouldn't hesitate a minute in recommending your Streamlined Reducing Valve."

FROM A BUTTON MANUFACTURER

We use the type '1000' valves on one of the **toughest operations** and they have operated 24 hours per day for the past 2½ years with **no maintenance."**

FROM A GLASS MANUFACTURER

"We have one set of five pressure reducing valves (CASH STANDARD '1000') on a Hartford Empire ZU forehearth that have **operated accurately** and **trouble free** for five years **without** a dimes worth of **maintenance."**

FROM A LAUNDRY

"We are well satisfied. We get **accurate pressure control under toughest working conditions — trouble-free service — cost-saving operation and practically zero in maintenance costs."**

FROM A CHEMICAL MANUFACTURER

"We purchased our first CASH STANDARD Type '1000' Streamlined Valve six years ago and since then we have installed more than 200 of the '1000' valves ranging in size from ¼" to 1½". This is indicative of our complete satisfaction with the operation of the '1000'. A large number of the pressure reducing valves are **operating above your maximum specifications of temperature and pressure** with excellent results.

"The **elimination** of **steam leaks** and the **low maintenance** cost have been especially gratifying. The low initial cost, **low maintenance,** and **trouble-free** operation results in the **most economical** pressure reducing valve we have been able to purchase."

1. **Maximum capacity when needed most.**
2. **Accurate pressure control under toughest working conditions.**
3. **Trouble-free service.**
4. **Smooth operation.**
5. **Tight closure.**
6. **Speedier production results.**
7. **Elimination of failures.**
8. **Cost-saving operation.**
9. **No spoilage.**
10. **Practically zero in maintenance.**

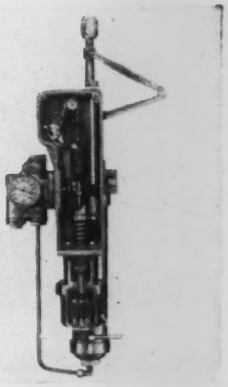
• WRITE FOR BULLETIN 962

CASH STANDARD CONTROLS . . . VALVES

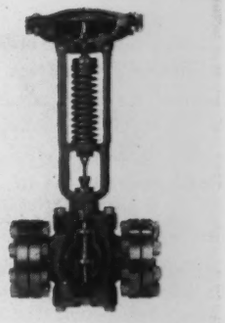
A. W. CASH COMPANY
DECATUR, ILLINOIS

BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

Send for them



Bulletin 963 features the CASH STANDARD Type 100 Series of Super-Sensitive Controllers — various types for automatically operating valves, dampers, rheostats, stokers, pulverizers, fans, and other apparatus. 16 pages filled with descriptions and applications.



Bulletin 968 features the CASH STANDARD Type 34 Pressure Reducing Valve — direct operated — direct acting for handling steam, hot water, cold water, air, oil, brine—and most liquids and gases except some injurious chemicals. Illustrates and describes the different styles available and tells about their applications. Three pages of capacity charts.

Bulletin 956 features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

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ONLY

Combustioneer

Has The

Automatic Respirator

WHICH CUTS FUEL COSTS UP TO 30%

Commercial Model No. 50

Combustioneer's Automatic Respirator, exclusive and patented, maintains at all times the precisely correct amount of air in the fire-bed for ideal combustion. There are no dampers or shutters in the air duct to adjust—operation is completely automatic. This assures maximum efficiency . . . *and cuts fuel costs up to 30%. Only* Combustioneer has it!

Combustioneer's exclusive "Pulsating" Transmission agitates the fire-bed, thoroughly mixing air and coal so that every particle is consumed. There is no waste. Its direct gear contact gives tremendous power. Its heavy-duty ruggedness assures long trouble-free service. Feed rate changes can be made easily while the stoker is in operation.

Twenty years of precision-engineering leadership have produced a complete line of hopper and bin-feed Combustioneers with capacities up to 1000 pounds per hour. They meet all heating needs in factories, shops, stores, theaters, hotels, apartment houses and other large private and public buildings.

Write today for the proof that a Combustioneer Automatic Coal Stoker can *cut your fuel costs!*

The Steel Products Engineering Co.
1238 W. Columbia St., Springfield, Ohio.

Please send us, without obligation, further information about your commercial models of Combustioneer, and information about your free heating analysis.

NAME_____

KIND OF BUSINESS_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

Hermetic Compressor Features Packaged Air Conditioner

No. 4135**—United Conditioning Corp., 74 Varick St., New York 13, is now in full production on its line of 3, 5, and 7½ ton "Clime-matic" self contained air conditioning units which feature "Copelmatic" hermetic compressors and which are water cooled.

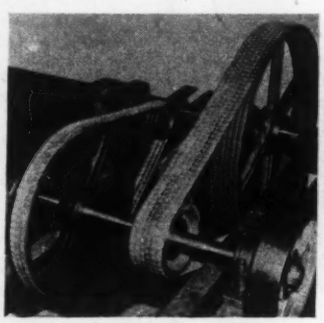
Normal air delivery is 400 cfm per ton and a variable pitch, adjustable fan pulley is said to permit a 25 percent increase in air delivery. Other features are said to include unusually large filter area, heavy duty coils four rows deep, the use of vibration isolation mountings, a visible "Freon" sight glass, and simple controls for either manual or automatic operation. For year 'round use, a heating coil may be added, and where wall or ceiling installation is necessary, the unit's two section construction is designed to permit remote installation of the machine compartment.

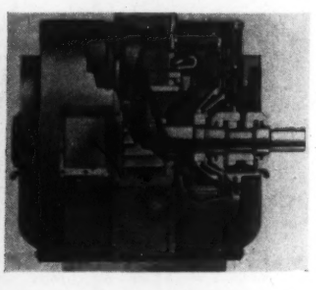
V Belting Serves Emergency Breakdowns, Reduces Inventory

No. 4136—"Vee Ply" belting has recently been added to the v belt drive line of Multiple-V-Drive Sales Div., Worthington Pump and Machinery Corp., P. O. Box 953, Buffalo 5.

Specially designed to service emergency breakdowns and eliminate a large, endless belt inventory, the belting is said to be suitable for most v belt drive applications, and to be ideal for use on drives requiring dismantling a part of the machine to install endless belts. According to the company, it reduces overall inventory by eliminating the need of carrying a spare set of endless belts for every machine. It is uncoupled from roll stock as needed and is adjustable to any length.

The belting is flexible and is recommended for continuous heavy duty service. It is not recommended, however, for severe shock loads or on drives that are underbelted.





Left, V Belting; *Right,* Motor

Copper Fin Construction Features Totally Enclosed Induction Motor

No. 4137—Type CS, totally enclosed, fan cooled, squirrel cage motors with copper fins embedded in the stator laminations for additional cooling are now offered by Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30. Because of the excellent heat transfer ability of copper, motors of this design require little more installation space than open motors of the rating, according to the company.

Rapid conduction of heat from the stator is accomplished by interleaving circular copper punchings at intervals among the core laminations. These copper fins

extend beyond the core iron so that the heat picked up can be transferred to the external cooling air. Additional copper fins are fabricated with steel parts to form large, cylindrical heat exchangers at both ends of the motor around the end turns. Heat picked up by internal air circulating through the rotor is transferred through these heat exchangers to the external cooling air.

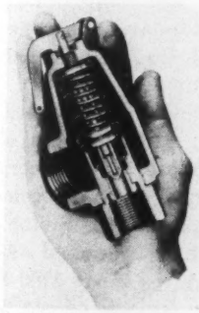
Motors are said to be suitable for application in central stations, cement mills, flour mills, coal pulverizing plants, grain elevators, steel mills, and in other locations where the atmosphere is contaminated with dust particles that are injurious to any open motor. Units are available in large ratings up to approximately 1500 hp.

Simplified Design Provides Large Capacity of Safety Relief Valve

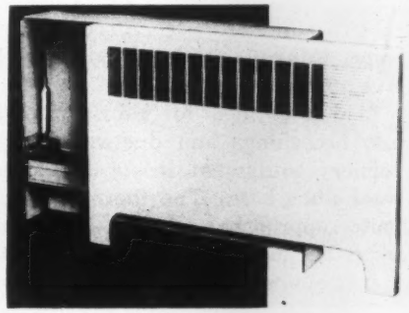
No. 4138—The No. 33 safety relief valve for hot water heating boilers, developed by McDonnell & Miller, Inc., Wrigley Bldg., Chicago 11, is designed to "provide a large capacity, Btu rated valve built to conform to the current ASME boiler code at a price within the reach of every boiler owner."

The valve, utilizing a new, simplified design, is set to open at 30 psi, the needle lifting just far enough to take care of the thermal expansion of water. If for any reason the temperature rises into the emergency zone, increased velocity is said to act on the "hydra-lift" ring, greatly increasing lifting power and snapping the valve wide open to dissipate heat at the maximum rate of 242,900 Btu per hr.

The valve cone and seat are of stainless steel and the testing lever operates independently of the automatic pressure action.



Relief Valve



Nonferrous Convector

Convector Tubes Soldered to Cast Iron Headers

No. 4139*—A new line of "National Art" nonferrous convectors for use with either steam or hot water is being marketed by National Radiator Co., Johnstown, Pa.

Heating elements consist of aluminum fins bonded to copper tubes and the spacing used is said to prevent clogging with dust. The tubes are silver soldered to cast iron headers which are prepared for soldering by a patented process similar to that used extensively during the last war. The manufacturer claims this special process "definitely assures a permanent bond of fin and tube."

Heating elements are supplied with specially designed enclosures for free standing, semi-recessed, full recessed, or wall hung installations. Made of reinforced sheet steel with a prime coat of paint, rounded corners, a front outlet grille, and an open bottom inlet arch, the enclosures are shipped completely assembled ready for instal-

Type 150 Suspended Unit Heater 60,000, 90,000, 120,000, and 150,000 Btu input capacities; for Natural, Manufactured, Butane-air, and LP-Gas.

NEW!

Mueller Climatrol

Gas-fired Suspended Unit Heater

. . . to meet a huge demand and bring extra sales to you

There is a constant demand for an attractive, compact, efficient, direct-fired gas unit heater — for use in stores, shops, theaters, garages, etc. And the new Mueller Climatrol meets that demand. Its special features give you an advantage over competition that will bring an extra volume of profitable sales to you. Here they are:

All-welded steel heat exchanger: Horizontal tubular design with high crown sheet; no impingement of flame. Completely cleanable from top or bottom without lowering unit.

Compact design — extra head room: Only 31″ high, including diverter and flue vent, on 60,000 and 90,000 Btu sizes. Larger sizes are only 35½″ high. Horizontal flue outlet on diverter.

Aerated flame burner: Cast iron with drilled ports. Single-opening shutter prevents clogging. Burner size increases proportionately with size of heat exchanger for uniform heat distribution.

Quiet, high-delivery blower: Discharge may be directed to suit installation by repositioning the adjustable louvers to blow horizontally or vertically.

This addition to the Mueller Climatrol gas-fired line is shipped complete, pre-wired, ready for quick, easy installation.

It's a new sales-maker for you. Get behind it and you're sure to increase your sales volume and profits. Write for details. *L. J. Mueller Furnace Co., 2006 W. Oklahoma Ave., Milwaukee 7, Wisconsin.* E-37

MUELLER Climatrol

REG. U. S. PAT. OFF.

because contacts get a GENERous WIPE

Unique spring suspension adds a self-cleaning action to the heavy, silver-to-silver contacts of Ward Leonard's 105 Heavy-Duty Midget Relays. These features make them self-aligning, too.

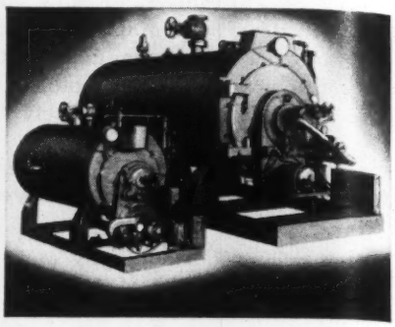
Use Ward Leonard 105 Midgets on jobs normally requiring heavier relays.

Write for Relay Catalog. Ward Leonard Electric Co., 24 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

WARD LEONARD ELECTRIC COMPANY
Result-Engineered Controls
RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

lation. Dampers also are available, either at time of installation or later on. Units are furnished in standard 6 in., 8 in., and 10 in. depths and standard 20 in., 24 in. and 32 in. heights. The nominal lengths of enclosures range from 20 to 64 in. in 4 or 8 in. increments.

Steam Generators Have Improvements in Basic Features



No. 4140—New steam generators developed by Cyclotherm Corp., 90 Broad St., New York City, are said to emphasize improvements in basic operating features.

A new type of "high atomizing" burner nozzle incorporates a primary air supply and, according to the company, assures precise injection of fuel and air for efficient combustion at all firing rates. In addition, the new nozzle design permits interchangeable oil or gas firing without requiring a change of nozzle.

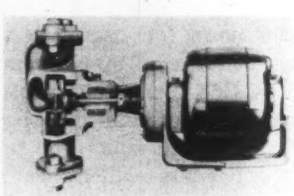
The new models also include a simplified air supply system, improved combustion and ignition programming controls, and a blower air channel design that is said to achieve quiet operation. Available sizes range from 10 to 300 hp for pressures from 15 to 200 psi.

Develops Finishing Cement for Industrial Equipment

No. 4141—A new "Powerhouse" finishing cement, said to eliminate from three to six standard application steps, is available from Baldwin-Hill Co., 500 Breunig Ave., Trenton 2, N. J.

Said to be ideal for industrial equipment such as boilers, breechings and ductwork, kilns, turbines, and oil refinery equipment, it is a dry, loose material of mineral wool fiber base. The thermal efficiency, says the company, approaches that of insulating cements. Suitable for either indoor or outdoor application, it is applied with a trowel and is said to resist temperatures up to 1700 F. It may be applied over any insulating block or plastic insulating cement.

Recommends Circulator for Radiant Heating Systems



No. 4142—The new HC low cost, horizontal type hot water circulator is said to have extra capacity for modern radiant heating systems. The manufacturer is Taco Heaters, Inc., 137 South St., Providence 3, R. I.

Features stressed by the company include porous bronze "Oilite" bearings, rotary seals, a spring drive coupling, a stainless steel shaft, a cast bronze impeller, two-bolt flanges, and a rotatable body.

Capacities at zero head are 42, 43, and 44 gpm respectively for the 1 in., 1¼ in., and 1½ in. size. The maximum head for all sizes at no flow is 7.5 ft.

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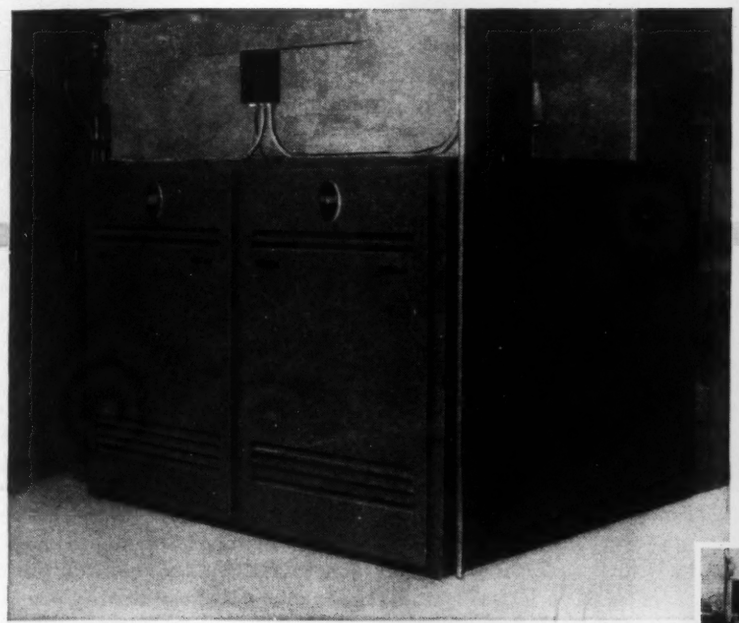
"BRYANT Winter Air Conditioning provides *Customer Comfort* AT LOW COST"

says A. Wilner, Owner-Operator, Western Auto Associate Store, Somerville, N. J.



Bryant Model BA-88 Winter Air Conditioning installation in Western Auto Associate Store delivers warm air to the store through overhead supply outlets. Return air is removed from the store at several points along the floor line. Heating contractors: Elling Bros., Somerville, N. J.

"Bryant Winter Air Conditioning does a very highly satisfactory job in our store... warms, filters, humidifies and circulates the air to provide comfort for customers and employees alike. We are happy to recommend Bryant Automatic Heating."

You can get a *full* share of the warm-air heating business in your area with the Bryant Model BA-88 Gas-Fired Winter Air Conditioner. The BA-88 has a place in the forced warm-air systems of all types of homes and helps create ideal indoor weather in offices, stores and other commercial applications.

These Bryant-engineered features set the BA-88 apart from ordinary warm-air equipment: All cast iron tubular heat exchanger for years and years of superior service and high operating efficiency; rugged cast iron burners with raised, *precision-drilled* ports (specifically drilled for the type of gas to be burned, whether it be natural, manufactured, LP or mixed gas); and the famous Bryant Diaphragm Valve and Automatic Pilot.

The Bryant Model BA-88 Winter Air Conditioner is fully enclosed in its sturdy steel jacket, requires a minimum of floor space for equipment of its type. It is made in seven standard sizes, with inputs from 60,000 to 250,000 Btu per hour.

Let the pup be furnace man ... and water boy, too!

bryant

AUTOMATIC HEATING

BRYANT HEATER DIVISION

Affiliated Gas Equipment, Inc.

Cleveland, Ohio • Tyler, Texas

THE MOST COMPLETE LINE OF GAS HEATING EQUIPMENT IN THE NATION

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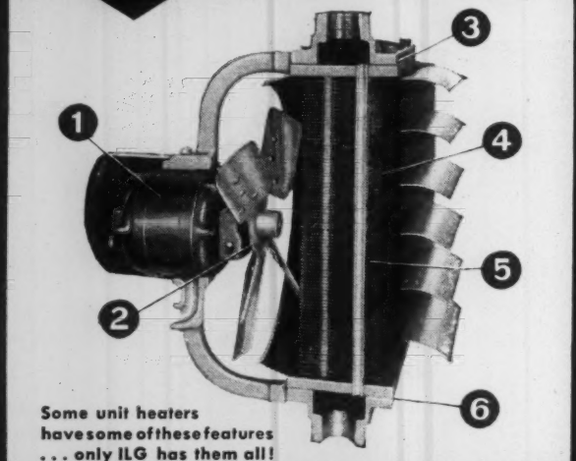
THE WORLD'S FINEST UNIT HEATER!

ILG

Extra quiet! Extra capacity! Extra economy!



Some unit heaters have some of these features . . . only ILG has them all!

One-name-plate . . 2-piece header . . No brazed joints

1. Patented ILG-built Self-Cooled Motor—never "slow roasts" due to radiated heat from core . . . saves 5% to 10% on power cost.
2. Dynamically balanced fan wheel—specifically designed for ILG Unit Heaters . . . verified for dynamic balance at rated speeds.
3. Two-piece header bolted together—graduated for "balanced" steam distribution. Trouble-free operation on steam pressures to 125 lbs.
4. Solid copper core . . . 26 gauge flanged copper fins pressed on to ½" O.D. seamless copper tubes. ILG *never* has substituted less efficient, less durable metals in its fins or tubes.
5. No welded, soldered or brazed joints. Pressing operation *permanently* unites fins and tubes. Brass orifice bushings driven into entrance of tubes to expand tubes uniformly into header.
6. Bottom Header—"Floats" on slotted coil retainer and spring washers—coil expands and contracts independent of unit casing.

PLUS the famous ILG "One-Name-Plate" Responsibility covering both unit and motor.

Sell nationally-advertised ILG Unit Heaters. Only ILG has all these features . . . only ILG offers so much value per dollar.

Send coupon today for FREE Unit Heater Bulletin 342

ILG Electric Ventilating Co.,
2841 N. Crawford Ave., Chicago 41, Ill.
Offices in more than 40 Principal Cities

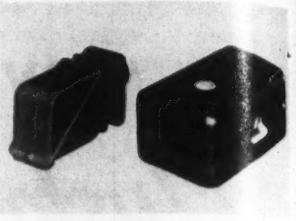
Firm Name _____

Your Name _____ *Title* _____

Address _____ *Zone* _____

City _____ *State* _____

Protects Commercial Oil Burner Combustion



No. 4143—To protect commercial size oil burners from flame failure and to provide automatic programming for these burners, Combustion Control Corp., 77 Broadway, Cambridge 42, Mass., is offering "Fire-eye" system FF-1. This includes photoelectric scanner type 45PH5 and programming control type 24PJ8.

The scanner consists of a phototube and vacuum tube amplifier housed in a dust tight aluminum case. The photoelectric system monitors the oil flame and, when flame fails, signals the programming control which starts the burner and programs a sequence of fuel valve opening, post ignition time, priming, and scavenging.

The equipment is said to incorporate many features, including a special heat absorbing filter on the scanner and a hinged shutter permitting lens cleaning without shutdown. The fuel valve delay and post ignition periods can be set upon installation in seconds, according to the company.

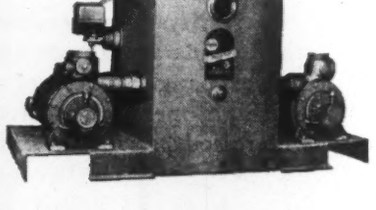
Evaporative Condensers Used for Many Applications

No. 4144—The evaporative condensers of Baker Refrigeration Corp., South Windham, Me., are designed for both indoor and outdoor use and for "Freon" and ammonia.

Model BU is of the outdoor-indoor type, incorporates centrifugal fans, and is available in capacities from 10 to 125 tons, "Freon" (7.1 to 89.1 tons ammonia). Maximum rated capacities of the model BC condenser are 100 and 71.3 tons, "Freon" and ammonia respectively. This model utilizes a propeller fan and is only for outdoor use.

Condensing coils are of the steel tube, all prime surface type and are tested to 300 psi air under water and are hot dipped galvanized after fabrication. Fan motors have ball bearings and a special tropical insulation to resist moisture. Centrifugal pumps are close coupled.

Returns Condensation in Low Pressure Systems



No. 4145—A line of simplex and duplex square tank condensation return units, equipped with "Apco" turbine type pumps, is available from Aurora Pump Co., 80 Loucks St., Aurora, Ill.

Units are designed to return condensation from radiators, coils, etc. to low pressure boilers. In industrial plants they may be used to return water and other liquids to overhead tanks of gravity circulating systems. The pump is of the double suction, turbine type with a flexible coupling and bronze fitted construction. The shaft is of stainless steel. The impeller is all bronze, and the float control is adjustable. Capacities are from less than 1000 to 15,000 sq ft EDR at pressures up to 40 psi.

Now...for the first time!

CIRCULAR AIR DIFFUSION FROM A SQUARE OUTLET

NEW SQUARE ANEMOSTAT Aspirating Air Diffuser Type E

ENGINEERS WANTED IT:

Up to the present, using a square air diffuser meant sacrificing performance for appearance. Now Anemostat has developed an *entirely new* square air diffuser . . . the Type E . . . that provides draftless air distribution over a full 360° arc.

This new patented Type E Diffuser retains the exclusive Anemostat *aspiration* principle. It draws room air, equal to 35% of the supply air, into the device, where it is mixed, within the unit, with the supply air before it is discharged in a multiplicity of planes.

ARCHITECTS WANTED IT:

Because of its square shape, this new diffuser harmonizes perfectly with rectangular and straight line design. It fits readily into standard size acoustical and egg crate ceilings. It can be combined with all types of lighting fixtures.

The Anemostat Type E is available in nine different neck diameters ranging from 4 to 14 inches.

CONTRACTORS WANTED IT:

It can be installed and adjusted quickly and economically by a new labor and time saving snap-on method. Equalizing deflectors also easily snap onto the inner assembly.

By adjusting the equalizing deflectors in the new Type E Anemostat, air can also be diffused in long, narrow or angular patterns to suit various conditions.

SEND FOR BULLETIN 29 which shows smoke test photographs and gives full information on the new Type E Air Diffuser.

ANEMOSTAT®

DRAFTLESS *Aspirating* AIR DIFFUSERS

ANEMOSTAT CORPORATION OF AMERICA
10 EAST 39th STREET, NEW YORK 16, N. Y.
REPRESENTATIVES IN PRINCIPAL CITIES

"NO AIR CONDITIONING SYSTEM IS BETTER THAN ITS AIR DISTRIBUTION"

ANEMOSTAT CORPORATION OF AMERICA, 10 EAST 39TH ST., NEW YORK 16, N. Y

Please send me a free copy of Bulletin 29 which fully describes the new Anemostat Type E *Square* Air Diffuser.

NAME .....

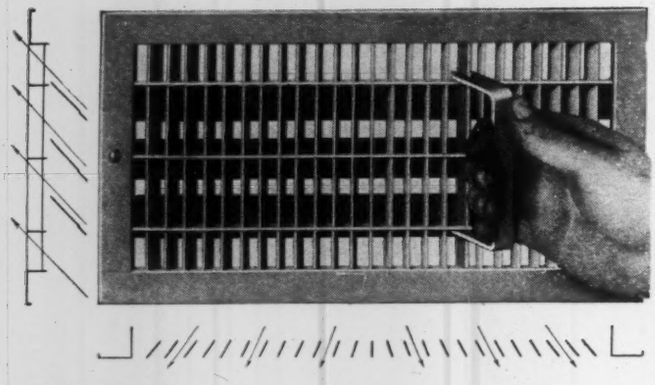
POSITION .....

COMPANY .....

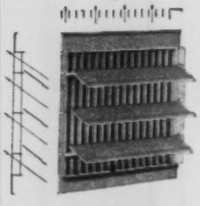
ADDRESS AC-12

INDEPENDENT

"Fabrikated" WALL GRILLES WITH DEFLECTING VANES



Style 321-A grille with deflecting vanes



Rear view showing adjustable deflecting vanes

ACCURATE and positive compound deflection of air flows can be readily secured with these "Fabrikated" grilles. Directional adjustments may be made when grilles are installed; or grille bars and vanes may be adjusted after installation to meet unforeseen or changed requirements.

Each grille bar and each deflecting vane is adjusted *individually* with a special two-pronged tool included with each shipment. Locking of grille bars and vanes is not required because they are held firmly in place — no vibration — no rattle.

Write for Our New Catalog No. 48.

MEMBER NATIONAL WARM AIR HEATING AND AIR CONDITIONING ASSOCIATION — INDOOR COMFORT

Always Leading—Always Progressing

THE INDEPENDENT REGISTER CO.

3747 E. 93rd STREET · CLEVELAND, OHIO

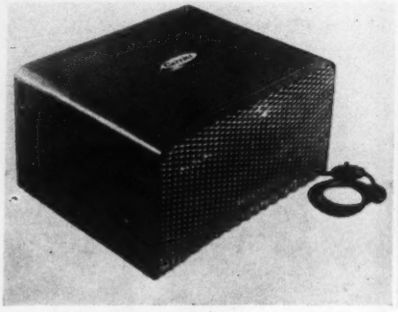
Refrigeration Type Dehumidifying Unit Has Large Capacity

No. 4146—A new, large capacity, semi-portable dehumidifying unit that operates on a refrigeration principle has been placed on the market by Carrier Corp., 302 S. Geddes St., Syracuse 1.

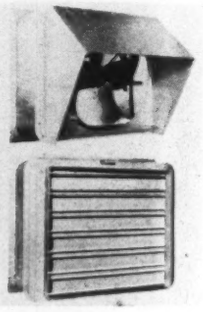
Built around a ⅓ hp condensing unit, the new 53F "Humidry" has a capacity for removing 34 pints of moisture per day under room conditions of 80 deg and 70 percent relative humidity. It may be installed in any convenient location and requires only an electric plug-in connection—110 or 230 volt 60 cycle a-c—and a floor drain for moisture disposal.

The unit is recommended for use where rust, mildew, mold, or rot causes damage, deterioration, or work delay.

Air is drawn over the chilled surface of a copper plate, fin type evaporator and moisture from the air is condensed, collected, and drained away. The cool air then passes over the warm condenser surface by forced circulation from a pressed steel fan and is recirculated around the room.



Dehumidifier



Window Fan

Propeller Fan Mounted on Outside Window Frame

No. 4147—Recommended for use in apartments, offices, stores, shops, etc., the belt driven type AP propeller fan has been designed for mounting on the outside of window frames. The manufacturer is Chelsea Fan & Blower Co., Inc., 1206 Grove St., Irvington 11, N. Y.

It is equipped with cord and plug and pull-chain switch and is available in 24 and 30 in. sizes. Air deliveries are 4500 and 6500 cfm. However, the 30 in. fan may be equipped with a ½ hp motor, and at 620 rpm it is rated at 8200 cfm.

Protects Cork Coverings From Solvent Products

No. 4148—A new material, "Solvopruf," which can be used as either an adhesive or finish for corkboard or cork covering to prevent damage to the insulation from solvent products has been developed by Armstrong Cork Co., Lancaster, Pa.

It is a self curing compound which may be applied by brush or trowel, and, according to the company, it sets to a rubber-like film at room temperature and remains in this condition when exposed to temperatures ranging from –35 F to plus 125 F. Upon aging six or seven days it is said to be resistant to the action of toluol, methyl ethyl ketone, gasoline, kerosene, and water. Although benzol causes it to swell, the protective film remains in a serviceable condition. It is recommended for use only with corkboard or uncoated cork covering.

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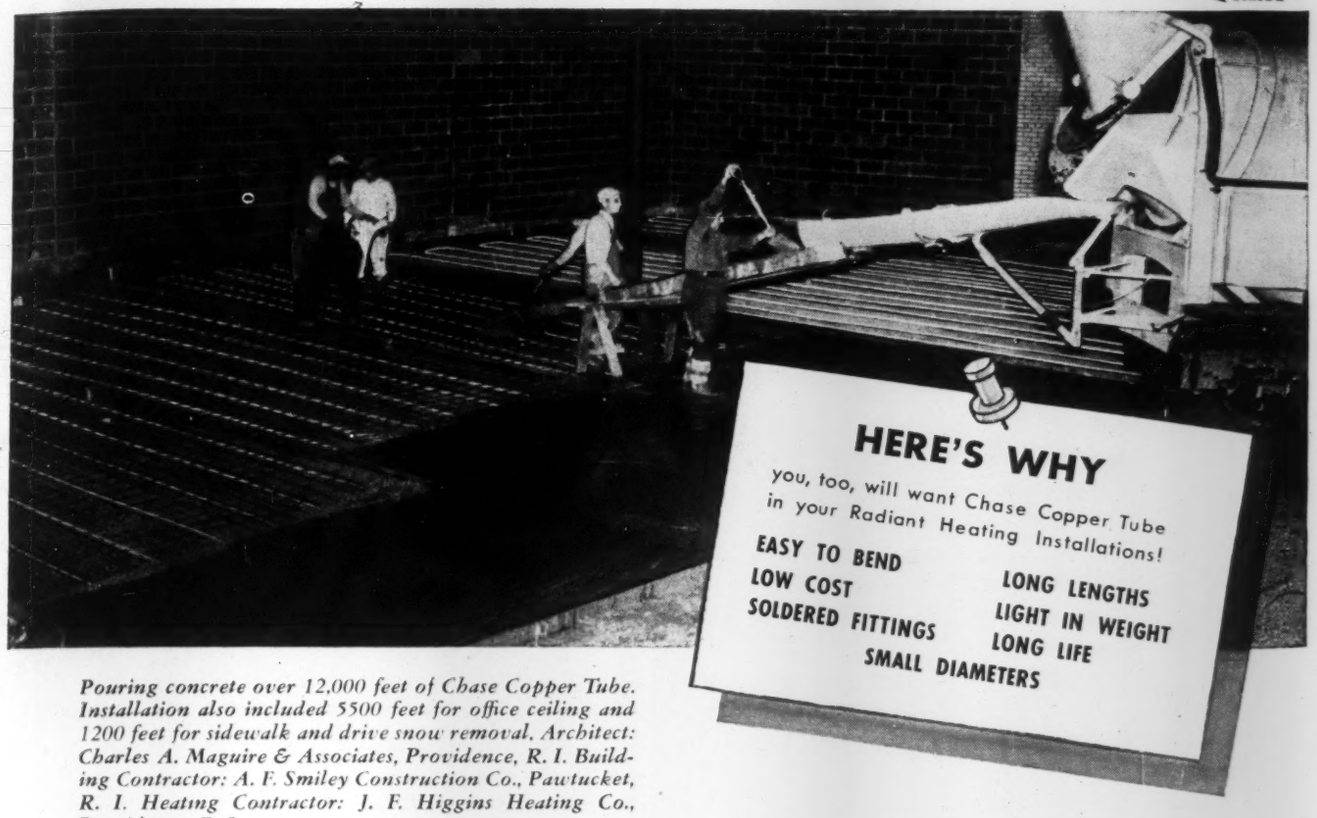
PROVIDENCE WAREHOUSE WITH 22,000 SQ. FT. FLOOR AREA USES CHASE COPPER TUBE FOR RADIANT HEATING!



HERE'S WHY

you, too, will want Chase Copper Tube in your Radiant Heating Installations!

EASY TO BEND
LOW COST
SOLDERED FITTINGS
LONG LENGTHS
LIGHT IN WEIGHT
LONG LIFE
SMALL DIAMETERS

Pouring concrete over 12,000 feet of Chase Copper Tube. Installation also included 5500 feet for office ceiling and 1200 feet for sidewalk and drive snow removal. Architect: Charles A. Maguire & Associates, Providence, R. I. Building Contractor: A. F. Smiley Construction Co., Pawtucket, R. I. Heating Contractor: J. F. Higgins Heating Co., Providence, R. I.

BIG jobs . . . little jobs, Chase Copper Tube has the advantages that mean fast, economical installation . . . dependability! For instance: you reduce costly, time-consuming connections because Chase Copper Tube is available in coils up to 100 feet long. Its flexibility means quick, easy hand-bending! And no fittings are needed at bends.

In floor installations, as illustrated, there's no need for accurate leveling of Chase Copper Tube. For ceilings, its light weight makes this overhead work easier . . . and its small diameter does not require extra plaster for coverage. Send for instructive, informative booklet that discusses radiant heating in theory and practice. Write Dept. HPA-99.

Send for **FREE** book
"Suggestions for Designing RADIANT PANEL HEATING with Copper Tube."
MAIL THIS COUPON TODAY!

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Please forward your book "Suggestions for Designing Radiant Panel Heating with Copper Tube."

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THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DALLAS DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILW
MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† ST. LOUIS SAN FRANCISCO SEATTLE WATERBURY (†Sales Offi

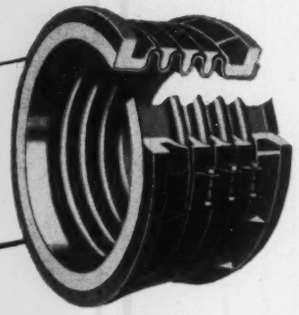
ANOTHER REASON WHY

Badger

IS FIRST IN

expansion joints

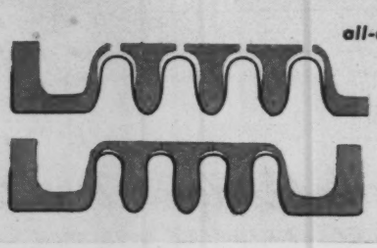
COMPACT



Installation and maintenance in tight places are easy when you use Badger Packless Corrugated Expansion Joints. Thanks to thoughtful designing, the outside diameter of any Badger Joint is about the same as any ordinary flange. It's one reason why users everywhere insist on the *original* Badger Packless Corrugated Joint. Here are other features equally important to you:

- Flexible . . . quick response to heat expansion cuts strain on adjacent fittings and equipment
- Packless . . . single tube construction provides pressure-tight joint without packing
- Special forming methods . . . no danger of structure-weakening stresses
- Controlled heat treating . . . to assure long life for flexing member
- Directed flexing rings . . . to equalize stresses *between* and *within* corrugations
- Fabricated from stainless steel or alloys . . . joints withstand high temperature and corrosion

These features are important in any pipe line job — you can get them all only by specifying Badger Expansion Joints.



Badger

MANUFACTURING COMPANY

230-260 BENT ST. CAMBRIDGE 41, MASS.

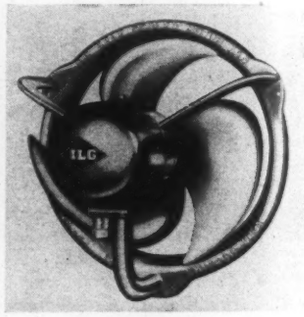
Air Diffuser Available in Square Form

No. 4149—A new type E square air diffuser, said to aspirate and distribute air equally over the full arc of 360 deg, has been developed by Anemostat Corp. of America, 10 E. 39 St., New York City.

According to the company, it harmonizes with rectangular and straight line architectural designs, is flush with the ceiling, fits readily into standard sizes of acoustical and egg crate ceilings, and can be combined with all types of lighting fixtures. The diffuser is available in nine different neck diameters ranging from 4 to 14 in.

Like the standard circular unit, it is said to provide 35 percent aspiration by virtue of its patented design. A snap-on method permits removal or insertion of the complete inner assembly together with equalizing deflector. Long, narrow or angular air patterns can be obtained if other than the full 360 deg diffusion is required.

Square Air Diffuser



Propeller Fan

Propeller Fan Has Self Cooled Motor

No. 4150—The type Q propeller fan of Ilg Electric Ventilating Co., 2841 N. Crawford Ave., Chicago 41, has been designed specifically for exhaust fan duty.

Outside air is drawn through a vent pipe, circulates through the motor, and is exhausted from the front of the motor into the fan air stream. New type fan blades are said to provide high capacity, efficiency, and exceptionally low noise level ratings. The unit is available in numerous sizes up to and including 30 in. fan wheels (7800 cfm rating).

Seal, Bearing Assembly Interchangeable on Rotary Pump

No. 4151—Worthington Pump and Machinery Corp., Harrison, N. J., has improved the design features on its rotary pumps by the incorporation of a new line known as "Gami." The new pumps employ the use of a mechanical seal and a self lubricating type inboard sleeve bearing to carry overhung drives. This seal and bearing assembly are interchangeable on the same shaft with the standard stuffing box of the GA type pump, so that if service conditions change, substitutions of seal or stuffing box can be readily made.

The seal, says the company, is subject to suction pressure only and has been found tight even at high vacuum. Units are designed for handling liquids comparatively free from abrasive or corrosive substances, and are said to be capable of handling a considerable amount of air or gas in the liquid. They are recommended for handling liquids of various viscosities from tar, molasses, and heavy oils to light liquids such as gasoline and kerosene.

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This Unique Insulation Product Has

NINE LIVES

★ SAVES FUEL

★ DEADENS METALLIC NOISE

★ OFFSETS OVERLOADS

★ IMPROVES APPEARANCE

★ REDUCES POWER LOAD

★ PREVENTS CONDENSATION

★ PREVENTS RUST

★ ABSORBS SOUND

★ REDUCES VIBRATION

Yes, DUX-SULATION *performs nine important functions in any heating, ventilating and air-conditioning system . . .*

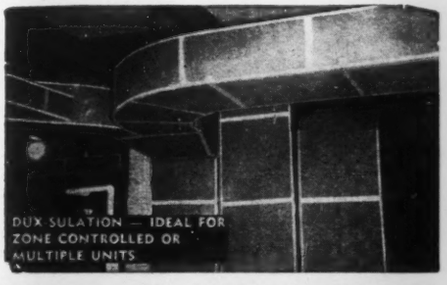
Asbestos-protected DUX-SULATION actually saves 75% of the heat loss that would otherwise be radiated from the ducts.

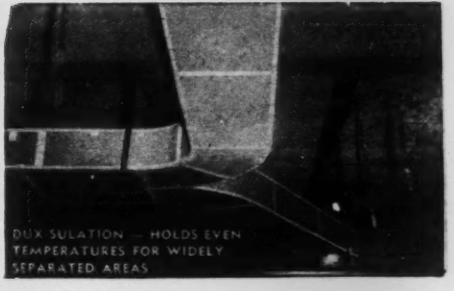
But, that's not all! DUX-SULATION performs many additional jobs, all of which are important in themselves—particularly the key functions listed to the left.

This unusual product can be applied to either the inside or the outside of round, rectangular, or irregular sized ducts. It is supremely flexible—will not chip, crack, or buckle. Furthermore, it is rot-proof, mildew-proof, and insect-proof.

DUX-SULATION is safe! The entire surface is protected with an asbestos membrane, and asbestos-protected tape is furnished for covering the corners and joints as well as adhesive for application. There is nothing else to buy —no wires, screws, bolts, or lugs are used. Comes in an easy-to-handle roll 36 inches wide—100 square feet ½" and 1" thick.

The greatest evidence as to the usefulness and durability of asbestos-protected DUX-SULATION is the fact that it is being used more widely each year, *and is specified again and again by leading Engineers and Contractors.*





FOR COMPLETE FACTS ON ALL PERFORMANCE ADVANTAGES, APPLICATION METHODS, AND OTHER DATA, SEND TODAY FOR "BULLETIN 400". WE WILL ALSO SEND YOU THE NEW SAMPLE KIT (RIGHT) WHICH INCLUDES ACTUAL SAMPLES OF DUX-SULATION.

Order Asbestos Protected DUX-SULATION from your Jobber today.

Grant Wilson Inc.

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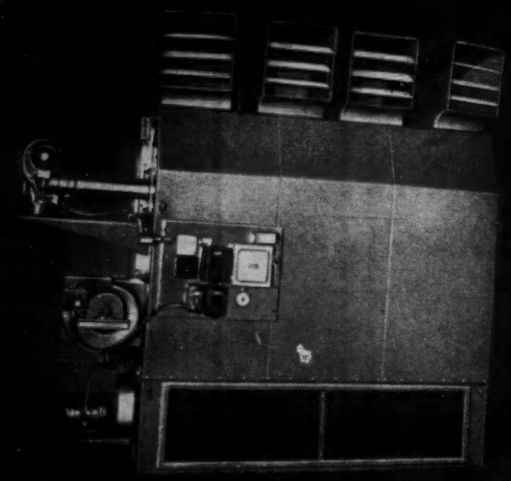

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AIRTHERM

Oil* or Gas Fired
Space Heaters

Airtherm space heaters are easy to install. They are furnished complete with all operating and safety controls for automatic operation. Airtherm space heaters have a steel combustion chamber lined with castable refractory for simple maintenance and long life.

Available in nine models ranging from 650,000 to 1,950,000 BTU per hour output in floor mounted or suspended types.

For detailed information write for Catalog 802

*Approved by Underwriters' Laboratories

AIRTHERM MANUFACTURING COMPANY

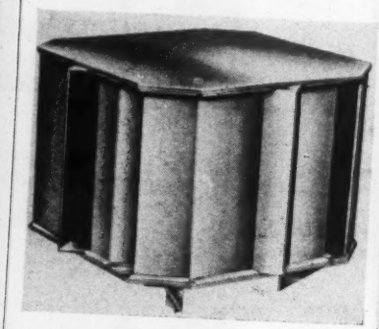
711 South Spring Ave. St. Louis 10, Mo.

Venturi Type Orifices Used in Roof Ventilator

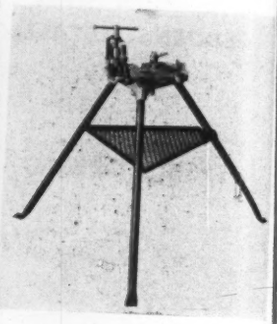
No. 4152—The "Agitair" CNO exhauster for roof ventilating, vent flues, and chimney tops has "venturi-type" orifices and is available from Air Devices, Inc., 17 E. 42nd St., New York 17.

According to the manufacturer, it does not restrict the flow of air or gases when there is no breeze, will not interfere with natural draft due to temperature differences, is weatherproof under all conditions, prevents down draft, and moves relatively large amounts of air at low wind velocities.

Constructed of heavy gage steel and having a corrosion resistant finish the unit has no moving parts and is available in standard head sizes from 5 to 48 in.



Roof Ventilator



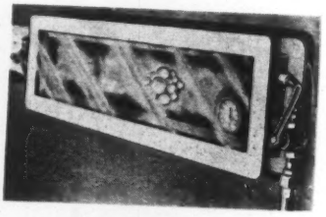
Pipe Vise

Pipe Vise Has Tool Tray

No. 4153—The "Tristand" pipe vise of Ridge Tool Co., Elyria, Ohio, features a tool tray designed to make the unit rigid.

Said to be a portable work bench, the unit includes a 2½ in. yoke or 4 in. chain vises, built-in, three size, pipe benders, an adjustable ceiling brace screw for anchoring the stand between the ceiling and floor with 1 in. pipe, slots for hanging tools, and a malleable iron tray for the oil can, dope pot, etc. The new tool tray hooks to lugs on the front legs and is locked on the back leg with a thumb screw on a sliding fitting. The feet have rubber pads.

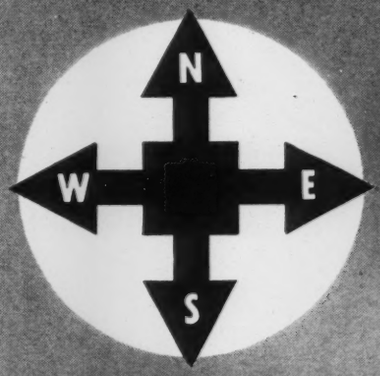
Locates Leaks in Pipes, Tanks, and Storage Vessels



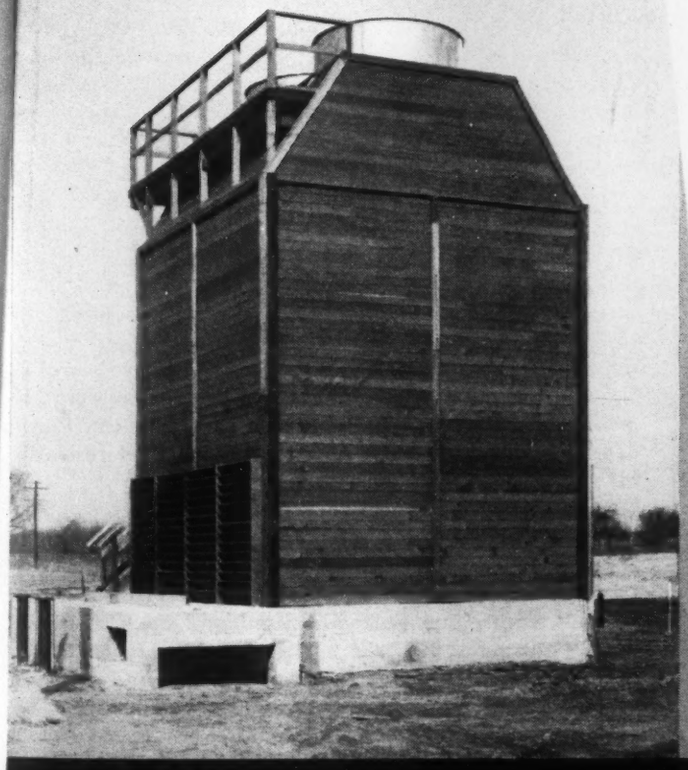
No. 4154—A device for quickly locating leaks in pipes, tanks, or other storage vessels is the vacuum seam tester offered by American Pipe & Steel Corp., 2201 W. Commonwealth Ave., Alhambra, Calif. It is a compact, portable unit said to effect substantial savings by often eliminating the necessity of taking out of service the old equipment to be tested.

Seams are covered with soap suds and an inspection box with a clear glass top and soft rubber base is laid over the seam. A vacuum, created within the inspection box, draws air through any leaks causing soap bubbles to form. These are visible through the glass top. Units are available in a wide variety of sizes and shapes for inside corners, outside corners, circumferential seams, and straight seams.

EXPOSED TO WIND



FROM ALL DIRECTIONS



Guaranteed Against Hurricane Velocities Up to 100 M.P.H.

No matter where C. H. Wheeler Water Cooling Towers are installed . . . whether perched atop a building . . . or in the clear on the ground . . . they all carry the same guarantee. Records of the United States Weather Bureau show that aside from tornadoes and tropical hurricanes, winds in excess of 100 M.P.H. are relatively infrequent in the United States (75 M.P.H. is hurricane velocity), therefore this guarantee means something. Further, with C. H. Wheeler Towers, water cooling performance and efficient operation with minimum water losses are also guaranteed. These assurances, plus 50 years' experience, explain why C. H. Wheeler Induced, Forced and Natural Draft Cooling Towers are installed in all parts of the U. S. Send for Cat. No. 145.

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Representatives in Most Principal Cities

C.H. Wheeler

STEAM CONDENSERS • WATER COOLING TOWERS
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OF PHILADELPHIA

JOHN ZINK

Whisper Quiet Model

UNIT HEATERS

Two Popular Models Available

WHISPER QUIET MODEL—For installations requiring quiet operation. More Head Room —Compact Design and More Heat From Gas Burned. A. G. A. approved for natural, manufactured, mixed or LP gases. Fully equipped with Automatic Controls.

HURRICANE MODEL—For Industrial Installations. This model is also compact in design, offering more Head Room and More Heat from Gas Burned. Will heat 40′ x 80′ space. A. G. A. approved for natural, manufactured, mixed or LP gases. Automatic Controls.

100,000 Btu/hr.

Both Models finished in Toast Tan Crinkle Enamel Baked on. Adjustable Louvers.

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CENTRAL HEATING PLANT

Can Be Installed In Attic Basement or Closet

Write for Literature

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New York — Salt Lake City — Houston — Los Angeles

Hot Water Circulator Operates Against Relatively High Heads

No. 4155—An improved model C hot water circulator designed to permit the use of smaller piping in heating systems has been developed by The Trane Company, La Crosse, Wis.

Built to operate against higher heads, it supersedes the model B circulator. Interchangeable flanges enable one size circulator to fit two sizes of heating system mains. One basic unit may be used for either 1 or 1¼ in. mains. A second basic unit is used in 1½ or 2 in. service. According to the company, it operates "efficiently and noiselessly" on both vertical and horizontal piping.

Equipment Shorts

A new $12 million steel plant, which will consist of three 225 ton open hearth furnaces and which will produce 400,000 tons of ingots per year, is now under construction at the Middletown, Ohio, plant of **Armco Steel Corp.** . . . The Distinguished Service to Safety Award of the National Safety Council has been conferred upon 13 plants of **Westinghouse Electric Corp.**, Pittsburgh. The 42,000 employees of these plants compiled a record of more than 90 million man-hours of work with less than three lost-time accidents per million.

Johnson Service Co., Milwaukee, recently concluded an intensive six-week training program for United States and Canadian graduates in mechanical engineering. The course, which included classroom discussion, demonstrations, laboratory work, and field trips, was given to men who will be assigned as sales engineers to company branch offices. . . . **Westinghouse Electric Corp.**, Pittsburgh, has put into effect a motor exchange plan for single and three phase, 1 to 20 hp, frame 203 to 326, a-c motors. Stocks of replacement motors will be maintained at company warehouses throughout the country.

When President C. E. Wilson and his staff recently visited the **Frigidaire Div., General Motors Corp.**, Dayton, Ohio, representative models of more than 400 separate refrigeration and air conditioning products now marketed by the company were lined up in display against 1941 counterparts. . . . A comprehensive 13-week course, scheduled from the middle of last month to December 2, is now in progress at the training school of **Brown Instruments Div., Minneapolis-Honeywell Regulator Co.**, Philadelphia. As in the past, courses are designed primarily for customers.

The Middletown, Pa., plant of **National Radiator Co.**, Johnstown, Pa., has been awarded a plaque by the National Safety Council for completing a 12-month period without a lost-time accident. Similar plaques were also won by this plant in 1940 and 1946. . . . **Manning, Maxwell & Moore, Inc.**, Bridgeport, Conn., has put into effect an inventory loss prevention policy covering the firm's 300 odd industrial supply distributors. The new price protection program is effective until the first of next year and applies to all shipments made direct to distributors for a period of sixty days after ordering.

Standard Stoker Co., Inc., Erie, Pa., producer of spreader stokers for steam locomotives, has entered the stationary power plant stoker field and has acquired complete

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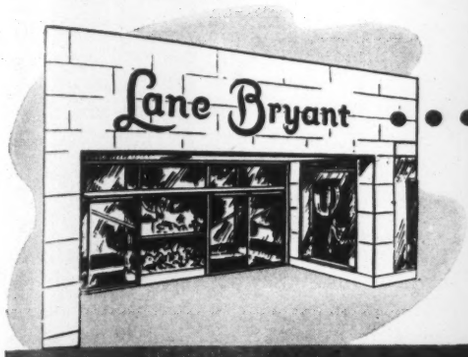


. . . Retail Chain Chooses AGITAIR®
To Help Sell Ready-To-Wear

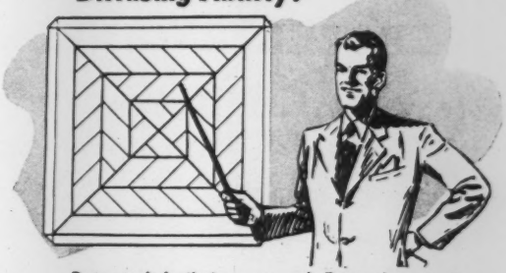
Sales floor in Lane Bryant's Detroit store where Agitair Type R's provide complete customer comfort.
Architects: C. N. Agree *Mech. Engr.:* A. F. Caughey *Air Cond. Contr.:* J. Brodie & Sons, Inc.

Correct air distribution means customer comfort . . . and customer comfort means more sales. That's why leading retail chains like Lane Bryant rely on Agitair Type R's noiseless, draftless air diffusion. These modern diffusers deliver 100% air distribution in any shape area from any location . . . blend perfectly with modern ceiling designs.

Write for Complete Data

AIR DEVICES, INC.
17 East 42nd St. • New York 17, N. Y.
AIR DIFFUSERS • AIR FILTERS • ROOF EXHAUSTERS

Here's the Secret of Greater Diffusing Ability:



Patented built-in vanes deflect the air in numerous divergent streams resulting in turbulence at the point of contact with the aspirated air. Result: Rapid mixing, diffusion and temperature equalization.

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SERIES "ES"

A New Webster

OIL BURNER

- **This combustion unit burns COLD #3 or lighter FUEL OIL.**
- **NO STEAM required for atomization or heating.**
- **Full AUTOMATIC operation.**
- **Design permits installation OVER gas burners.**
- **NO FURNACE DRAFT required.**
- **Capacities rated from 26 to 208 HORSEPOWER.**
- **SMOKELESS operation with NOMINAL EXCESS AIR.**

Webster combustion installations are engineered from blueprints to operation

For SERIES "ES" OIL BURNER Information write—

THE WEBSTER ENGINEERING COMPANY

P. O. Box 2168 - Tulsa, Oklahoma

Division of
SURFACE COMBUSTION CORP.
Toledo, Ohio

control of the Chicago Automatic spreader stoker. . . . Salesmen from wholesalers in New England, New York, Ohio, Michigan, and Illinois recently attended a class at the Michigan City, Ind., plant of **C. A. Dunham Co.**, Chicago. The four day program, under the chairmanship of Assistant Sales Manager Walt S. Browning, covered construction, application, design features, and the installation of company products.

Air Filter Corp., Milwaukee, has made substantial price reductions on its viscous type permanent air filters. Increased production facilities and more efficient operation are said to provide savings which are being passed on to customers. . . . District managers and company representatives attended the recent annual summer sales meeting of **Combustioneer Div., Steel Products Engineering Co.**, Springfield, Ohio. A new gear case, to be incorporated in the firm's commercial stokers, was introduced.

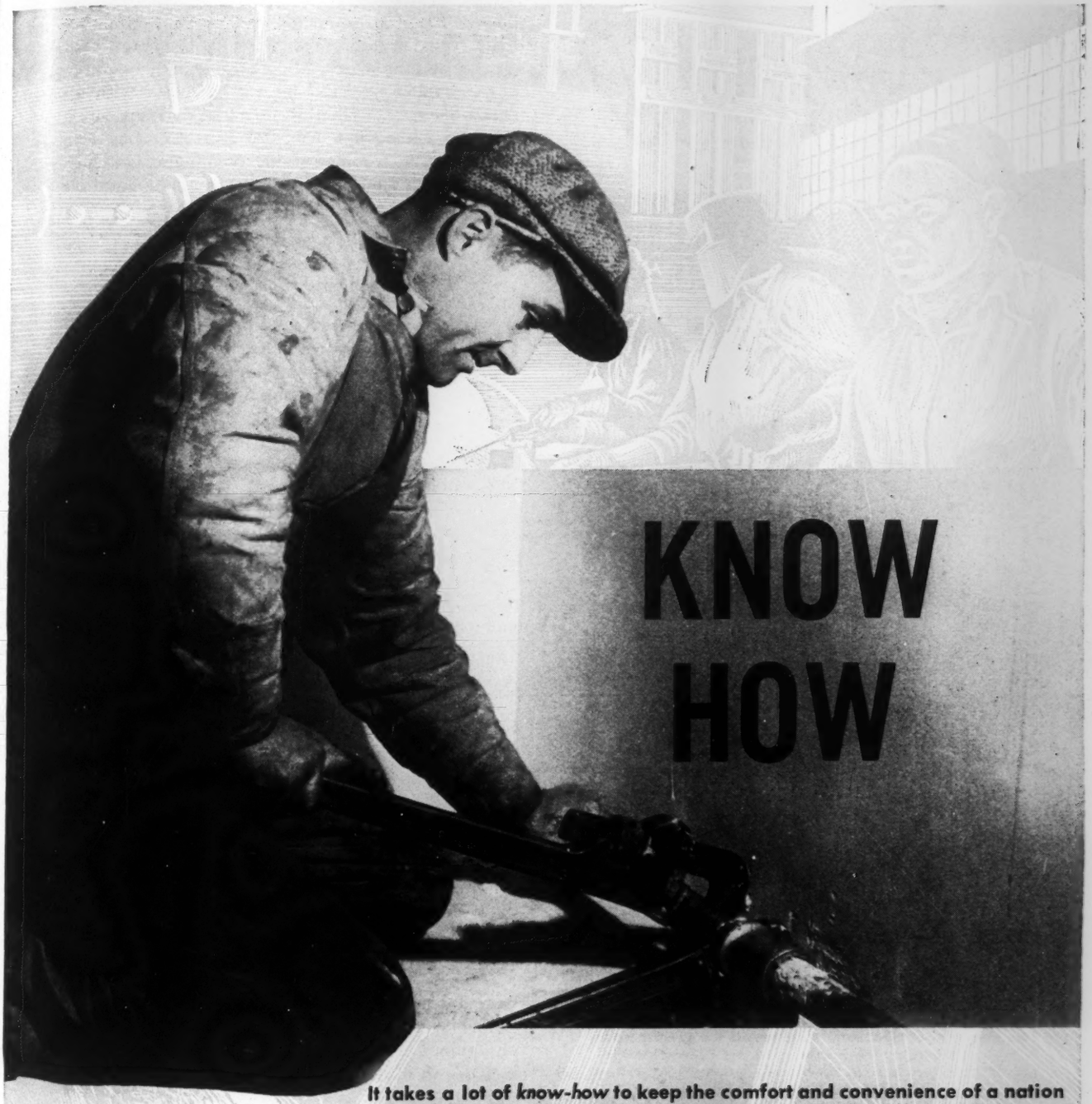
The Junior Achievement unit sponsored by **Pyle-National Co.**, Chicago, won first prize in the recent National Industry Awards Competition. The winning entry, submitted by this group of young people, was a bronze nutcracker in the form of an alligator. . . . A robot "announcer," on duty 24 hr per day, is keeping management employees of **Westinghouse Electric Co.**, Pittsburgh, informed of company news. By dialing a special number on telephones, supervisory employees can listen in while a continuous tape reels off the latest developments. The device is designed to keep supervisors at all levels abreast of policy and labor relations matters, new orders secured, production loads, backlogs, etc.

The asbestos insulating cement of **Grant Wilson, Inc.**, Chicago, is now being distributed in a restyled and modernized package which is designed to attain high visibility in store displays. . . . **Tenney Engineering, Inc.**, Newark 5, N. J., has developed a large number of refrigeration testing units for all types of research in which simulated natural conditions are desired. A new unit, developed with engineers of The Texas Co., is completely valved so any part of the system can be bypassed during testing operations. Three different types of low side evaporators are completely interchangeable and expansion valves are located both inside and outside the cabinet.

Other features of the unit designed for Texaco include reversible feeds on the top and bottom of the evaporators, visual inspection sight flow glasses, and provision for complete pressure and temperature measurements.

The type ABS "Autocon" alarm silencer has been developed by **Automatic Control Co.**, 1005 University Ave., St. Paul, Minn., to eliminate the danger of forgetting to close hand opened knife switches in alarm circuits. Designed for use with any type alarm circuit, it is said to provide protection even though the warning sound is stopped. When an emergency condition arises, the alarm is stopped by pressing a button on the side of the case. A red light remains on until the trouble is corrected. When the circuit is clear, the silencer resets itself and the light goes out.

Leonard Precision Products Co., Garden Grove, Calif., is offering a new "Tubemaster" which has a capacity for



It takes a lot of *know-how* to keep the comfort and convenience of a nation on call from the turn of a faucet, or the flip of a switch—*know-how* in *making* pipe and *know-how* in *installing* it.

That's why we at Wheatland are proud of the thousands of tons of "pipe with the yearmark" that are going into the plumbing, heating and air-conditioning systems of new homes all over the nation.

Made by men who *know* pipe, it's top choice with men who use pipe!

-pipe with the yearmark!

WHEATLAND TUBE COMPANY

BANKERS SECURITIES BUILDING • JUNIPER AND WALNUT STREETS • PHILADELPHIA 7, PA.

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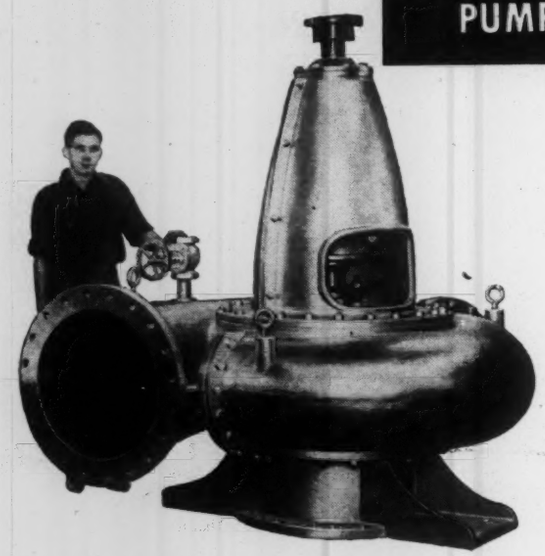
IMPROVED

VOLUTE
MIXED FLOW
PUMPS



Economy redesigned for

MAXIMUM EFFICIENCY
SMALLER MOTORS

If you're pumping solids . . . not large enough to require regular non-clog slow speed sewage pumps . . . you'll find Economy volute mixed flow pumps the answer to your problem. Engineered for greater economy in operation, the Economy mixed flow volute line, tested and proved in twenty-two years of operation, has now been redesigned for still higher efficiency.

Built to keep pumping longer at lower cost, these pumps are equipped with the highest duty bearings available, including double row, angular contact thrust bearings. Large size pumps also have a self-aligning, spherical roller radial bearing.

Capacities range from 3,000 to 50,000 G. P. M., heads from 10 to 50 ft. For complete details, write Dept. C-9.

Centrifugal, axial and mixed flow pumps for all applications.

Economy Pumps Inc.

Division of Hamilton-Thomas Corp.
HAMILTON, OHIO

flaring, flanging, squaring, and burring either ferrous or nonferrous tubing, ⅛ to 5 in. in diameter. Where required, tooling is available for beading operations. The new model is powered by a 2 hp motor with a variable speed drive. . . . "Spot-It' terminal markers, produced by **Western Lithograph Co.**, 220 Rose St., Los Angeles 54, may be used for identifying terminals, switches, panels, etc. The self adhesive markers are applied without moistening and are said to adhere securely to any wire end or terminal.

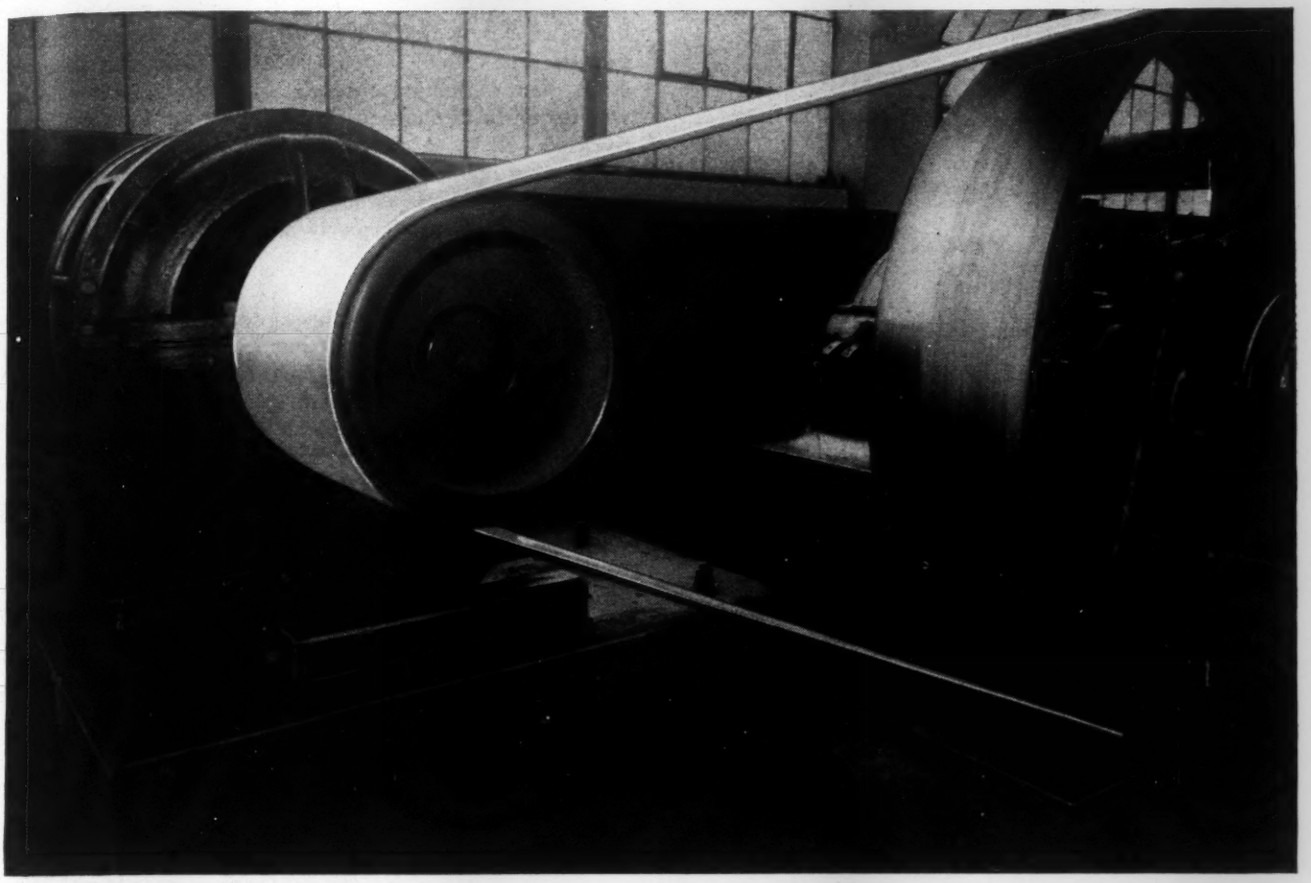
"Kool-Grips" fit around hose near the nozzle end and are designed to provide a cool place for the operator's hand. The outside covering is of molded rubber secured to a curved metal base which is crimped to hold it away from the hose and provide air space. Units are clamped on the hose by tightening four screws. The manufacturer is **Duffy Industries**, 536 S.E. 6th Ave., Portland 14, Ore. . . . A new 1 or 2 hp low cost 6:1 ratio variable speed control is now available from **Speed Selector, Inc.**, 118 Noble Ct., Cleveland 13. A spring loaded sheave is mounted on the motor shaft while the control sheave is mounted on the driven shaft. A hand operated regulating mechanism opens and closes the control sheave and the change in pitch diameter is said to cause the v belt to actuate the spring loaded sheave. According to the company, any standard "B" section v belt may be used and remote control can be easily applied.

"Hep" is a chemical solvent said to be nontoxic, noninflammable, and harmless to the skin. It was developed by **Wagner Tool and Supply Corp.**, Long Island City, New York, and is offered to those engaged in refrigeration repair for removing sludge and hard blackened deposits found in "stuck-up" compressors and sealed units. All deposits, says the firm, are softened or dissolved within a few minutes after immersion and may be simply wiped off. . . . **Eutectic Welding Alloys Corp.**, 40 Worth St., New York 13, has marketed a new cabinet, the "Eutec-Wall-Pack" especially designed to service the welding needs of small shops. It is a wall cabinet which will accommodate from seven to nine different types of the company's welding rods in standard packages. One model is arranged for those having only torch welding equipment, another for those with arc welding equipment, and the third caters to both arc and torch welders.

A low melting point, ribbon type solder, ⅜ in. wide and flux containing, is being marketed by **Proved Products Mfg. Co.**, San Fernando, Calif. The amount of solder required is placed where wanted and heat is applied either with a match or a soldering iron. It is recommended for applications such as soldering close to low melting plastic insulation, for radio and air conditioning equipment, etc.

U. S. Plug & Fitting Co., Canton, Ohio, is producing a line of magnetic plugs ranging in sizes from ¼ to 1½ in. According to the company, normal wear of piston rings, gears, and other moving parts often deposits small ferrous particles of abrasive metal in the lubricant. The magnet attached to the plug is used to remove and hold ferrous particles from a moving lubricant. All plugs have the Dryseal thread and are interchangeable with any standard Briggs type pipe thread.

DRIVE YOUR COMPRESSOR *more* EFFICIENTLY



WITH RHOADS *Tannate-Rockwood* SHORT CENTER DRIVE

The single strand Tannate leather belt with its high coefficient of friction and correctly maintained tension will deliver your motor power to the compressor with less loss than most drives, and retain its efficiency over a long period. Its resistance to many chemicals, moisture and machine oils assures lower maintenance costs and longer useful life.

The Rockwood pivoted motor base helps maintain an operating efficiency of 97-98% over a wide range of loads, automatically maintaining correct belt tension regardless of load fluctuation. This means smoother and more constant speed and maximum delivered power.

A Rhoads representative will be glad to discuss the advantages of this short center drive as it applies to your special needs.

Send for the 16 page, illustrated booklet describing the Rhoads TANNATE-ROCKWOOD method of driving compressors, fans and pumps . . . IT'S FREE FOR THE ASKING!

PRODUCERS OF FINE LEATHER FOR 247 YEARS

J. E. RHOADS & SONS

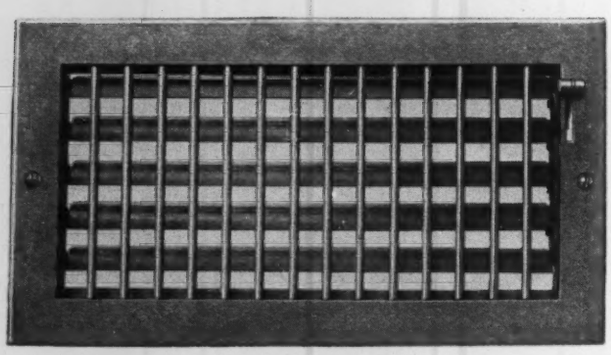
35 NORTH SIXTH ST., PHILA. 6, PA.

NEW YORK • CHICAGO • ATLANTA

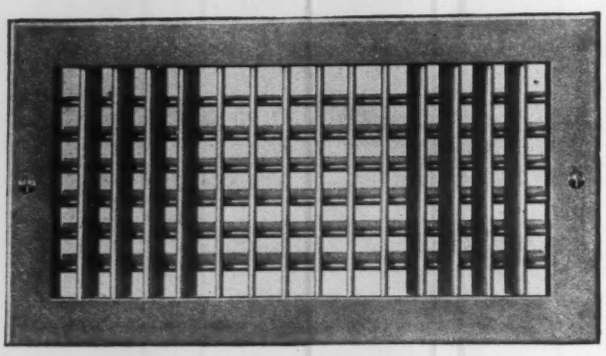
New AUER de luxe

"Streamliner"

Multiple Deflection
Air Conditioning
REGISTERS and GRILLES
— for high velocity outlets



1005V-HML. Single bank of bars, multi-louvre valve.



1205VH. Double bank of bars, no valve.

Streamliner registers and grilles for air conditioning systems provide *better* diffusion for high velocity outlets. The Series includes models with single bank of adjustable bars (vertical or horizontal), also with double bank of adjustable bars (vertical in front and horizontal in back, or the reverse), also all above four types with horizontal multi-louvre valves in the rear, controlled by lever on face of register.

Design of bars and method of mounting them are *original* with Auer. Bars are hollow moulded, beveled, perfectly formed, smooth in contour, and pivoted in the frame on special split sleeves. This expansion insert furnishes correct tension to hold bars firmly where set, yet allows sufficient free movement for adjustment with one simple tool. Bars may be set at any angle, in any grouping. Blades of multi-louvre valve are pivoted on rivets to prevent vibration. Streamliner® registers are equipped with gaskets. You will be pleased with the beauty and fine craftsmanship of these registers. Write for folder S-49.

Complete Auer Register Book—or Catalog "G" on perforated grilles—sent on request.

THE AUER REGISTER CO., 3608 Payne Ave, Cleveland 14, Ohio

Auer REGISTERS
& GRILLES for AIR CONDITIONING & GRAVITY

WHO'S WHAT

Carroll M. Baumgardner, vice president for sales, and **Benjamin T. Hain,** vice president for manufacturing, have been elected to the board of directors of **National Radiator Co.,** Johnstown, Pa. **John G. dePass,** general credit manager, is now assistant secretary. As a result of recent increases in orders for cast iron radiators, the Trenton, N. J., plant is being reopened. . . . **Charles V. Fenn,** who was formerly in charge of direct sales for **Carrier Corp.,** Syracuse, N. Y., in the southeastern section of the country, is now manager of direct sales with headquarters at the home office. He is succeeded in the Atlanta district by **Russell H. Gray,** formerly assistant manager of direct sales in Syracuse.

J. F. Fitzsimmons has been named manager of the commercial research department, **Allis-Chalmers Mfg. Co.,** Milwaukee, succeeding **J. R. Reed** who has resigned to establish his own business. Mr. Fitzsimmons became supervisor of the department's market research section in 1946. . . . **W. B. Connor Engineering Corp.,** New York City, has appointed **Robert D. Welsh** advertising manager. He was formerly assistant sales promotion manager of Thermoid Co. . . . As the new manager of sales administration and forecasting of the automatic heating division, air conditioning department, **General Electric Co.,** Bloomfield, N. J., **William A. Mulcock** is responsible for customer service, coordinating sales with production, compiling sales forecast data, and supervising outside warehouse operations. He had been manager of commercial service since 1947.

The position of manager, west coast sales, **Worthington Pump and Machinery Corp.,** Harrison, N. J., is now being held by **John P. McArthur.** With headquarters in San Francisco, he is supervising activities in district offices in that city, Los Angeles, Seattle, and Salt Lake City. He had been manager of the San Francisco office since 1945. . . . Replacing **Roland M. Spencer** who has been appointed Kansas City district manager, **John C. Scott** is managing the Chicago contract department, **Powers Regulator Co.,** Chicago.

Wagner Electric Corp., St. Louis, has named **R. E. Bryant** manager of the automotive and electrical branch at Buffalo. He has been a salesman in the Pittsburgh office. . . . **Wayne McCarthy** has been promoted to the position of northwest regional manager, **Minneapolis-Honeywell Regulator Co.,** Minneapolis, succeeding **John B. Banks** who has resigned to take a position with another firm. With headquarters in Portland, the firm's northwest region includes areas surrounding that city, as well as Seattle, Spokane, and other cities in Washington and Oregon. **Wayne E. Petersen,** who has been on the company sales staff in Des Moines, succeeds Mr. McCarthy as branch manager in that city.

Fred H. Pillsbury, recently elected vice president in charge of operations, **Century Electric Co.,** St. Louis, joined the organization in 1927. At the time of his promotion, he was serving as executive engineer. . . . **William M. Hankins,** special sales representative for Kuhlman Builders Supply & Brick Co., has joined **Owens-Illinois**

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PROBLEM

1 HEAT LARGE VOLUME CORROSIVE SOFT WATER ECONOMICALLY—SAFELY

2 DELIVER WATERS OF TWO DIFFERENT TEMPERATURES

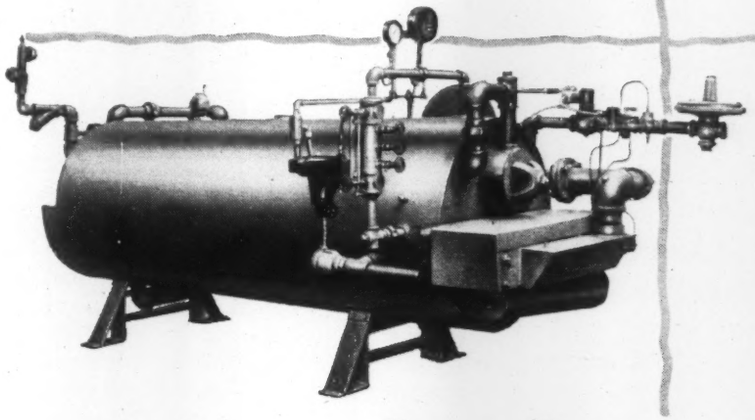
3 PROVIDE STEAM FOR SPACE HEATERS

SOLUTION

Simple . . . the Sellers Indirect Water Heater. A new design incorporating the proved advantages of Sellers Immersion Firing, it will handle pure zeolite softened water, corrosive soft water, medium soft water and waters of high oxygen and carbon dioxide content without damage to equipment and without expensive pre-treatment. It provides a continuous supply of hot water in large volume.

At the same time, two water blenders may be installed at the outlet to deliver waters of two different temperatures. Steam up to 15 pounds is available for space heating or other purposes.

Essentially the Sellers Indirect Water Heater is a simple combination of a special large capacity steam boiler and an instantaneous heat exchanger. Since little or no make-up is required, shell and tubes are not affected by corrosion.



For details, request your copy of Bulletin No. 1202. Write: Sellers Engineering Company, 4876 North Clark Street, Chicago 40, Illinois.

Sellers

INDIRECT WATER HEATER

STEAM TYPE

IMMERSION AUTOMATIC WATER HEATERS • BLAST HEATERS • AIR HEATERS COMBUSTION UNITS • INDUSTRIAL GAS BURNERS • IMMERSION TANK HEATERS • VERTICAL STEAM BOILERS • GAS COMBUSTION EQUIPMENT

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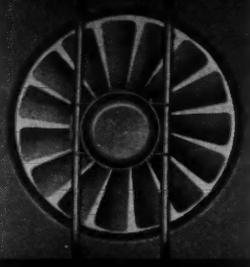
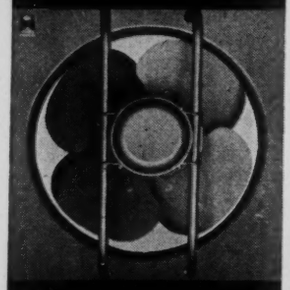
FOR FAST, QUIET AIR MOVEMENT INSTALL

Peerless Electric

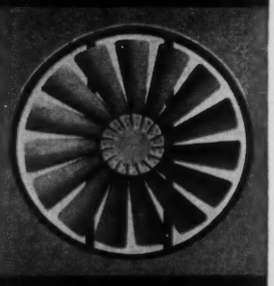
PROPELLER FANS



Type PV Multiblade



Type PVS Deluxe



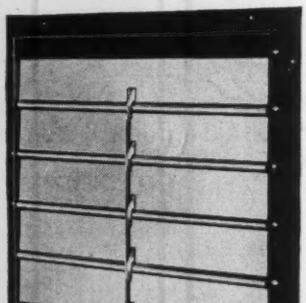
Type PV Multiblade

★

NO matter what your need for quiet, variable speed, attractively designed fans, you'll find the answer in a Peerless Electric design.

A combination of specially engineered capacitor motors and perfectly balanced extra wide blades produces extremely quiet operation. Motors are totally enclosed and permit installation in either a vertical or horizontal position.

These fans are supplied in single-speed, two-speed or three-speed operation and finished in gray. Recommended for stores, restaurants, hotels, offices and similar installations where quietness of operation and attractive appearance are prime requisites. Write for descriptive folders.



Automatic Louvers

Peerless Electric automatic louvers are designed especially for use with propeller fans. When the fan starts, the air stream instantly opens the louvers, which close by gravity when the fan stops. Completely weatherstripped around the inner edge of the frame. Built of high grade aluminum. Sizes from 10 to 48 inches.

THE Peerless Electric COMPANY

ESTABLISHED 1893 • WARREN, OHIO

MOTORS • FANS • BLOWERS

Glass Co., Toledo, as general sales manager of the Kaylo division which manufactures a new group of building material and insulating products recently developed . . . **William H. Corwin** is the new public relations director of **Taylor Instrument Companies**, Rochester, N. Y. He joined the firm in 1942 as a member of the advertising staff and since 1943 has edited the company's house organ.

Fairbanks, Morse & Co., Chicago, has appointed **Frank M. Mason, Jr.**, director of engineering. For several years he has been manager of the research division in charge of all research, developments, and patents. He remains in the headquarters office. . . . **White-Rodgers Electric Co.**, St. Louis, has opened a new branch office at 3-219 General Motors Bldg., Detroit. **Charles M. O'Brien** is the district manager in charge. . . . **Dr. Amos Turk**, formerly of the chemistry department, City College of New York, is now director of research and development for **W. B. Connor Engineering Corp.**, New York City.

Frank L. Snyder, whose entire business career has been with **Westinghouse Electric Corp.**, Pittsburgh, is now manager of the firm's transformer division in Sharon, Pa. He has succeeded **John K. Hodnette**, vice president, who recently became general manager of industrial products with headquarters in Pittsburgh. . . . **Combustion Engineering-Superheater, Inc.**, New York, has divided the sales territory formerly covered by W. Z. Harrison & Co., Salt Lake City. The Denver firm, **Joy & Cox**, now handles Montana, western Wyoming, Idaho, and Utah, while the state of Nevada has been assigned to Combustion's Los Angeles office.

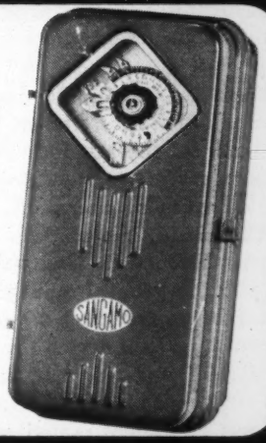
Frank J. McCusker has joined **Fitzgibbons Boiler Co., Inc.**, New York, as a sales representative in the Philadelphia area. In the heating business for many years, he was formerly with The Trane Co., John J. Nesbitt Co., Hajoca Corp., and more recently, Iron Fireman Mfg. Co. as Philadelphia district representative. . . . **Dravo Corp.**, Pittsburgh, has appointed **Clisby Associates, Inc.**, 904 Sixth Ave., N, Birmingham, Ala., distributor for its direct fired air heaters in central and northern Alabama and distributor for its crane cab coolers in all of Alabama and northwest Florida. Operated by Irwin Clisby and H. B. Hanson, Jr., the firm represents several manufacturers.

Frank W. McCann, previously head of centrifugal pump sales at the Indianapolis, Ind., works of **Peerless Pump Div., Food Machinery and Chemical Corp.**, Los Angeles, has been named manager of Atlantic district sales with headquarters in New York City. His territory includes all of New England and the middle Atlantic states. **Robert H. Hull**, formerly located in the Los Angeles works in charge of sectional sales of the vertical pump line, has replaced Mr. McCann at Indianapolis.

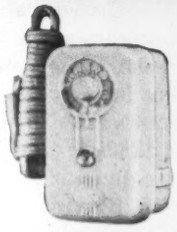
The new sales representative for **Ridge Tool Co.**, Elyria, Ohio, in the inter-mountain territory is **L. C. Richardson** who will cover Missouri, Kansas, Colorado, Arkansas, and Wyoming. He is not a newcomer to the pipe tool field, his previous experience including 13 years with Stockham Pipe Fittings Co. and Grinnell Co., Inc. His new headquarters are in St. Louis. . . . **William J. Tunny** joined **Youngstown Sheet and Tube Co.**, Youngstown.

Sangamo Type S Time Switch—This compact, single pole, single throw switch offers precision in miniature. Extremely attractive in appearance, it will suggest many "upstairs" installations. It is adaptable to switchbox mounting.

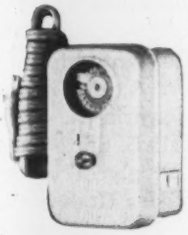
SANGAMO TIME CONTROLS



Sangamo Type L Time Switch—A high quality, heavy-duty, synchronous time switch for more extensive use. It can be equipped with an omitting device to provide daily shutoff periods.



Sangamo Interval Timers, primarily designed for attic fan control, are available in both standard (Type T) and "plug-in" (Type TJ) models. They are suitable for many applications.



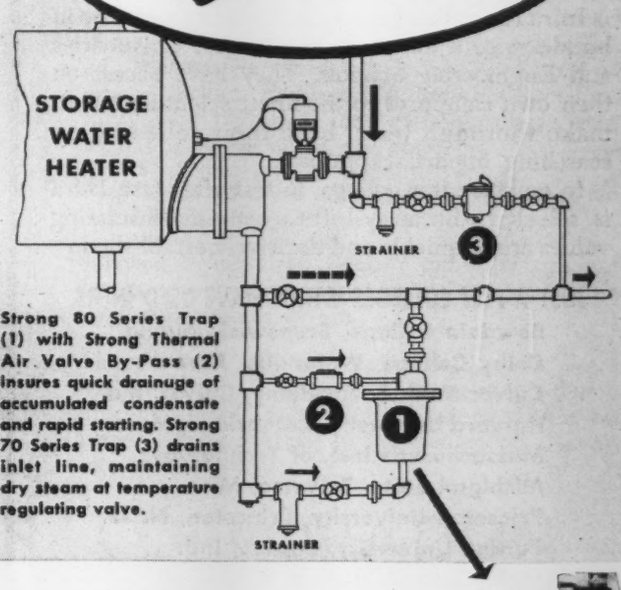
Sangamo also offers a new portable "plug-in" Time Switch. The Type SJ, rated 10 amperes or ¼ h.p., at 120 volts A. C. Just plug it in and it goes to work.

Bulletins on Sangamo Time Controls are available on request.

SANGAMO ST4917
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

50TH ANNIVERSARY SANGAMO 1899-1949

GET *Proper Drainage!*

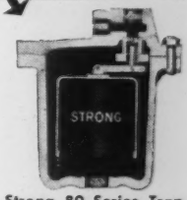


Strong 80 Series Trap (1) with Strong Thermal Air Valve By-Pass (2) insures quick drainage of accumulated condensate and rapid starting. Strong 70 Series Trap (3) drains inlet line, maintaining dry steam at temperature regulating valve.

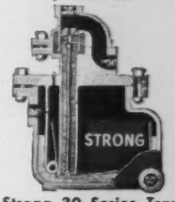
PROBLEM: Condensate accumulates in coils due to lack of pressure when thermostatic regulating valve is throttling or closed. *Improper drainage and water hammer result when thermostatic valve opens.*

SOLUTION: *Drain coils fast.* Use trap with four to eight times capacity of actual steam condensate rate. For medium or high pressures, either open or inverted bucket traps are suitable. *Use open bucket traps for low pressures.*

Completeness of the Strong trap line enables our engineers to recommend exactly the type or size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc., forged, welded, cast or semi-steel construction. Bring your drainage problems to us for solution. Send for Strong Trap Catalog No. 68 today for complete details of *all* Strong traps.



Strong 80 Series Trap for medium or high pressures.

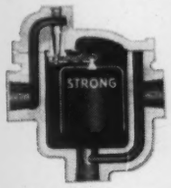


Strong 30 Series Trap for high, medium or low pressures.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio
REG. TRADE MARK
ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve



70 Series Trap

Strainer

STRONG

INFRA Insulation Pleases the Professors

Infra Insulation has had remarkably wide use in buildings of a long list of Colleges, Universities and Engineering Schools. They have access on their own campuses to the finest scientific talent, make thorough tests, base their selection on searching, impartial appraisal.

In college after college, in test after test, Infra is selected—because Infra's superior insulating values are so quickly and decisively established.

JUST A FEW COLLEGES WHICH HAVE USED INFRA

Bowdoin College, Brunswick, Maine
Colby College, Waterville, Maine
Culver Military Academy, Culver, Ind.
Harvard University, Cambridge, Mass.
Massachusetts Inst. of Technology
Michigan State, Traverse, Mich.
Princeton University, Princeton, N. J.
Purdue University, Purdue, Ind.
Wells College, Aurora, N. Y.

Infra's multiple separated aluminum sheets provide 4 reflective spaces and 4 reflective surfaces, each non-condensation-forming. Two sheets of aluminum and the accordion partition block convection currents. Infra's triangular reflective air spaces and small mass eliminate conduction as a problem.

INFRA C FACTORS AND ROCKWOOL EQUIVALENTS

C.052 Heat Flow Down, equals 6" Rockwool.
C.093 Heat Flow Up, equals 3½" Rockwool.
C.10 Lateral Heat, equals 3 1/3" Rockwool.

Thermal Factors Printed on Every Infra Carton

WRITE Infra for details and FREE COPY of "Bulletin No. 38," issued by the National Housing Agency of the Government, reporting tests of Aluminum Insulation made by the U. S. Bureau of Standards, and dealing principally with the problems of heat transfer and condensation.

Address Dept. **AC**

MULTIPLE ACCORDION ALUMINUM & TRIANGULAR REFLECTIVE AIR CELLS

Infra INSULATION, INC.
10 Murray St., N. Y., N. Y.

Ohio, 30 years ago. Recently, he was made superintendent of electrical maintenance at the firm's Indiana Harbor plants.

The air conditioning department, **General Electric Co.**, Bloomfield, N. J., has franchised a new parts depot. **A. E. Borden Co.**, with new offices at 176 Brookline Ave., Boston, and with customer sales facilities at 1383 Boylston St., will handle the sale of condensing units up to and including 10 hp, will stock repair and replacement parts of all condensing units (as well as sealed units for replacement purposes), and will serve the area including Maine, New Hampshire, Rhode Island, and parts of Massachusetts. Approximately 60 similar depots have been set up throughout the country.

Bryant Heater Div., Affiliated Gas Equipment, Inc., Cleveland, has named **R. A. Bissell** sales promotion manager. He has been in the headquarters office since December 1948 and he joined the New York factory branch in 1945. Previously, he spent 13 years with Brooklyn Union Gas Co. as district heating supervisor. . . . **Weathermatic Corp.**, Long Island City, N. Y., handling equipment of Carrier Corp., is engaged in the sale, engineering, installation, and service of air conditioning and refrigeration equipment. Its newly elected president is **Irving M. Fisher**, formerly in charge of the marine section, air conditioning department, General Electric Co.

William H. Compton has been manager of the Rockford, Ill., sales office of **Reliance Electric & Engineering Co.**, Cleveland, for the last four years. He has been promoted to supervisor of standard motor sales with headquarters in the company's general office. . . . **Tinnerman Products, Inc.**, Cleveland, has made a number of recent personnel changes. **Robert C. Overstreet**, formerly executive assistant to the general manager, is now secretary. Named director of engineering a year ago, **W. H. Taylor** is the new assistant to the vice president. **L. H. Flora**, recently named chief engineer, had been serving as chief development engineer, and **R. A. Hartman**, former chief product engineer, has been named manager of field engineering. Mr. Flora and Mr. Hartman have also been appointed to the executive committee.

Dr. Louis C. McCabe has returned to the **United States Bureau of Mines** as chief of the air and stream pollution prevention research division and will assist mineral industries in improving methods and devices for preventing the emission of harmful substances from mines, mills, smelters, and other installations. He will also serve as assistant chief of the fuels and explosives division under Dr. A. C. Fieldner. . . . **Air Purification Service, Inc.**, Newark, N. J., has named **Tri-State Distributing Co.**, 1415 S. State St., Salt Lake City, distributor for its glycol and glycol vapor equipment. The territory served includes Utah and surrounding states.

Officers for the 1949-50 season of the **Smoke Prevention Association of America, Inc.**, are: president—**Louis J. Cudbird**, chief engineer, Department of Property, Toronto; 1st vice president—**Louis C. McCabe**, U. S. Bureau of Mines; 2nd vice president—**W. E. Sample**, Baltimore & Ohio Railroad; secretary-treasurer—**Frank A. Chambers**, chief smoke inspector, Chicago; sergeant-at-

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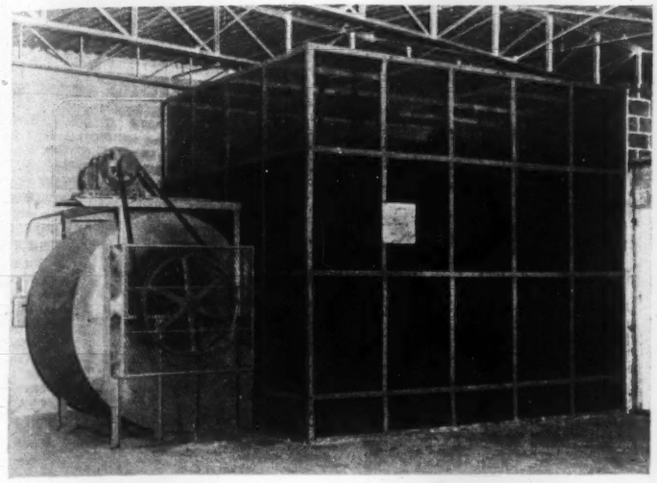
JOHNSON DIRECT-FIRED AIR-ROTATION HEATERS

ARE DOING A BETTER HEATING JOB AT LESS COST



200,000 to 5,000,000 BTU in single units.

The Johnson System of Air-Rotation (Pat. Apl'd. For) circulates large volumes of warm air to all parts of an open building without piping or ducts, and heats the building faster than any other method. It keeps the warm air at the "working level", which means comfortable working conditions throughout the plant, regardless of outside weather, and it means warm, dry floors.

Fast heat recovery is assured even when large loading doors are frequently opened and closed.

Johnson Direct-Fired Heaters are fully automatic in operation, using either light or heavy oil, coal with stoker firing, or gas.

The Johnson Heater is revolutionary in design. Multiple banks of criss-cross air heating tubes are placed directly over the fire for maximum heat transfer from the fire to the heated air delivered into the building.

JOHNSON HEATER CORPORATION

12 Newhall Avenue **Saugus, Mass.**

YOUR BEST BUY IS BY Bendix AVIATION CORPORATION

VIBRATION ELIMINATORS

Wherever you are faced with the problem of piping refrigerant gases and liquids under varying degrees of temperature and vibration, Bendix Seamless Flexible Metal Hose is the perfect answer. Deep parallel corrugations, uniform wall thickness and seamless construction assure greater flexibility—longer service life.

Engineered to your requirements.

Rubber covered where desired.

Made by Eclipse-Pioneer Division • Bendix Aviation Corporation • Teterboro, N. J.

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about the NEW

HAJOCA OIL BURNER

Watch for Announcement of Dates when this Great Oil Burner will be Demonstrated at your Nearest Hajoca Branch.

The Hajoca Oil Burner has been developed after years of research and study and is entirely new in every respect. It has been thoroughly tested for more than a year in typical homes. Results of these carefully conducted tests of Hajoca Oil Burners have shown fuel savings as high as 30% over burners they replaced.

Don't miss the opportunity to see the New Hajoca Oil Burner demonstrated. You'll be interested in the many new features which have been incorporated in this most modern domestic burner . . . features that will give your burner sales a big lift this fall.

Be sure to watch for local announcements telling the time and place where demonstrations will be held in your locality.

MAIL COUPON FOR INFORMATION ABOUT PROFITABLE DEALER PLAN

P-6

I'm interested in the Hajoca Oil Burner dealer plan. Rush information at once.

Company_____

Address_____

_____

Your Name_____

HAJOCA CORPORATION

31 Branches Serving the Atlantic Seaboard

From Newark to Tampa and inland to Chattanooga

Consult your local telephone directory for your nearest branch

General Offices: 31st and Walnut Street Bridge

Philadelphia 4, Pa.

arms—**Joseph M. Dorrer,** Chicago Junction Railroad; public relations director—**D. A. Sullivan,** Commonwealth Edison Co., Chicago.

R. W. Lawinger, president, S. F. Reynolds Co., Inc., is the newly elected president of the **Heating, Piping, and Air Conditioning Contractors Chicago Association.** Other officers now serving with him are: vice president—**C. E. Crone,** president, Charles E. Crone Co.; treasurer—**C. W. Johnson,** president, C. W. Johnson, Inc.; secretary—**A. Kilander. J. S. Kearney,** president, Northwestern Heating & Plumbing Co., and **W. H. Bodinus,** district manager, Carrier Corp., were elected members of the board of directors. **Louis T. Braun** continues as executive secretary.

William H. Scheick, coordinator of the Small Homes Council, University of Illinois, has been appointed executive director of the **National Research Council's** new building research advisory board. This board has been established to correlate, coordinate, and stimulate research in the several sectors of the building industry. . . . Operating out of the central district headquarters in St. Louis and covering parts of Missouri, Nebraska, and Iowa, **Daniel D. Kelly** is now a sales engineer with **L. J. Mueller Furnace Co.,** Milwaukee. He has been a heating and air conditioning sales engineer in the St. Louis area for the last 12 years.

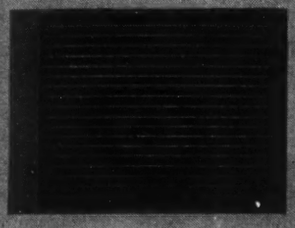
Well known to Detroit business men, **Allen Dean** is now managing sales for **A. V. Cauhorn Co.,** Detroit distributor for Airtemp, Div. of Chrysler Corp., Dayton. For the past two years he has been sales manager for the Paul Bunyan Co. . . . Changes and additions to the sales engineering staff of **Lincoln Electric Co.,** Cleveland, have recently been made. **E. E. Goehringer** is now district manager in the Indianapolis area. **Omer Blodgett** has been transferred to the Chicago office, and in addition to his duties as sales engineer, has a special assignment in engineering applications for redesigning to welded steel fabrication. **R. L. Hall** and **Robert Hirsch** have been assigned to the Pittsburgh office as district engineers.

Additions to field sales personnel for three district offices have been made by **Reliance Electric & Engineering Co.,** Cleveland. **Emory G. Orahood, Jr.,** formerly a sales engineer in Birmingham, Ala., has been transferred to Atlanta and is the first direct representative of the company in that area. **Robert B. Reed,** who has been handling steel mill sales work in the Gary, Ind., district, takes over the Birmingham post, and **John Drollinger, Jr.,** a recent electrical engineering graduate, has been assigned to the Detroit office.

Two new distributors have been appointed in the Pittsburgh area for the triethylene glycol air cleansing and humidifying unit of **National Air Conditioning, Inc.,** Johnstown, Pa. They are **Demmler Bros. Co.,** 100 Ross St., and **Anchor Sanitary Co.,** 213 Water St. The latter also handles the products of National Radiator Co., of which National Air Conditioning is a division. . . . **Himelblau Associates,** manufacturers' representatives, have moved to larger quarters, which include a warehouse, at 4234 W. Taylor St., Chicago. Products, to be handled by the firm, of two recently acquired accounts

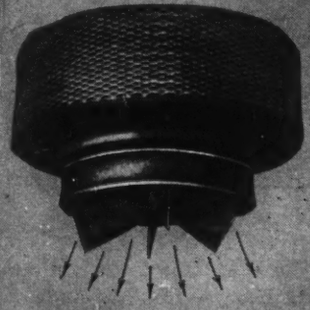
McCORD
HEATING AND AIR CONDITIONING PRODUCTS

BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES



All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS



A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

HORIZONTAL TYPE UNIT HEATERS

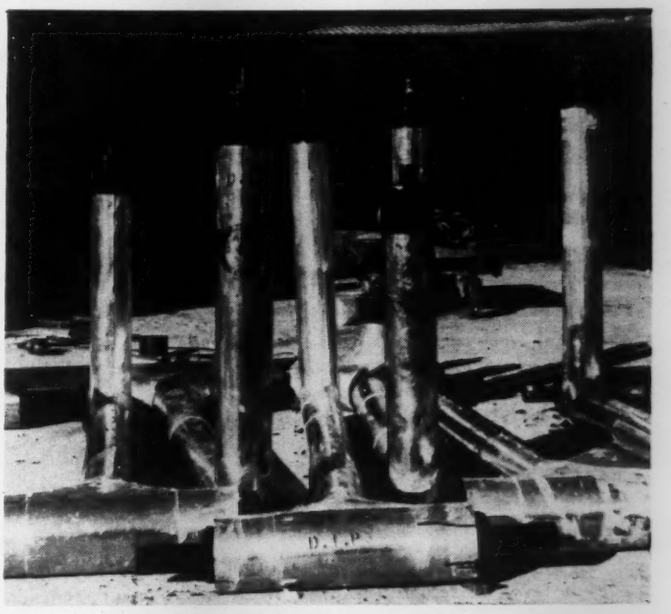
A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p. s. i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

Save fuel with McCord Unit Heaters.

McCord CORPORATION
DETROIT 11, MICH.

D.I.P. ENGINEERED
for Positive Protection

REG. U. S. PAT. OFF.



Combine Minimum Field Costs with Long Term Dependability

• DURANT Pre-Sealed INSULATED PIPE is the ORIGINAL positive protection to maintain low heat loss in the conveyance of steam, hot water, or refrigerants in underground or exposed piping. It is completely waterproof and eliminates corrosion and electrolysis.

Many leading architects and engineers specify D. I. P. wherever long term dependable service is required. Both installation and maintenance costs are kept at a minimum. No tile or masonry protection is required and field joint work is a simple four step process.

Our representatives, conveniently located in principal cities, are at your service. Or we will be glad to provide catalog and engineering data on request.

PRE SEALED

REG. U. S. PAT. OFF.

DURANT INSULATED PIPE COMPANY
1015 Runnymede St. East Palo Alto, California

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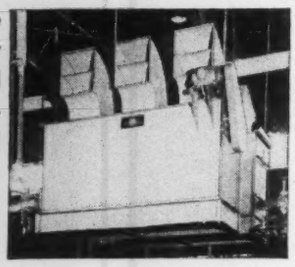
New HIGH PRESSURE STEAM Fan Heater Gives Savings You Never Had Before

The first heater to make High Pressure Steam really trouble-free and practical in plant heating. Every engineer should understand its original method; write for Niagara Bulletin and performance data.



HOW IT OPERATES: —

Dual coil system uses both sensible and latent heat. High pressure steam enters upper coil, shown on diagram below. Condensate drains into a trap. Then this high pressure condensate is released into the header of lower coil, instantly flashing into steam at vapor pressure.

Any high pressure condensate that remains liquid is carried to vapor condensate return header by drain tube that also gives off its heat into air stream.

Vapor condenses in lower coil. Its condensate is kept at a high level in return leg by a wier in the return header and sub-cooled by contact with coldest air entering heater. Vacuum condensate return to boiler is vapor free.

HOW IT SAVES IN COST: —

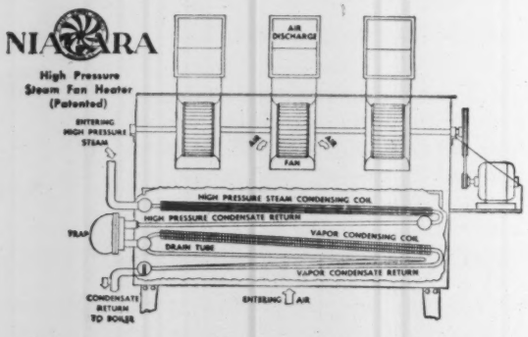
Piping is much smaller, simpler and less costly than in low pressure systems. Big traps and valves are not needed.

HOW IT SAVES IN OPERATION: —

Waste is prevented. Every BTU goes where you want it. No dump traps or hot wells waste live steam.

HOW IT SAVES IN UPKEEP: —

Condensate flow is even, vapor free, easily handled. No sudden surges of condensate in starting. No hammering, no hard wear and tear on system. Final air temperatures are not excessive; heat easily directed where needed; no flashing of low pressure condensate.



NIAGARA BLOWER COMPANY
Dept. H.P.
405 LEXINGTON AVE., NEW YORK 17, N. Y.
Please send Bulletin 109 on the Niagara High Pressure Steam Fan Heater.
Name .....
Address .....

are air dryers of **Bryant Industrial Div., Affiliated Gas Equipment, Inc.,** and heat transfer equipment of **Richard M. Armstrong Co.**

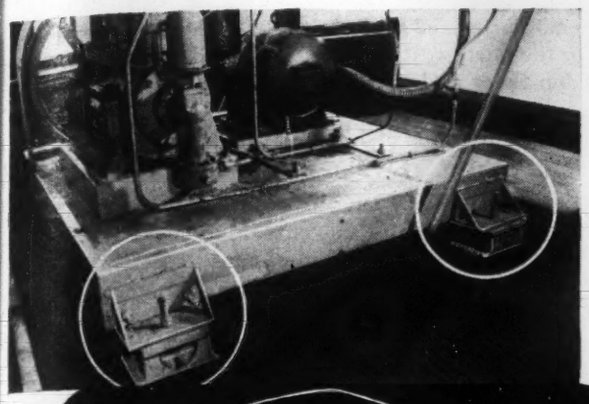
Harry A. Cooper, president, Cooper Alloy Foundry Co., is the newly elected president of the **Alloy Castings Institute.** Other recently elected officers serving with him are: vice president—**R. W. deWeese,** Electric Steel Foundry Co.; executive secretary and treasurer—**E. A. Schoefer,** of the institute; on the board of directors for a three year term—**B. J. Gross,** president, Key Co., and **M. G. Moore, Jr.,** president, Empire Steel Castings, Inc. . . . **Globe Steel Tubes Co.,** Milwaukee, has appointed **John A. Rhodes Co., Inc.,** Springfield, Mo., as a distributor of its seamless welding fittings and flanges. A complete line will be stocked.

Raytheon Mfg. Co., Waltham, Mass., has named **Art Cerf & Co.,** 744 Broad St., Newark, N. J., sales representative for its voltage stabilizers in upper New York state. He has been a sales representative in this area since 1939. . . . **T. C. Werbe,** president of **Lynch Mfg. Corp.,** Toledo, since its incorporation in 1928 and an officer of predecessor companies since 1917, now occupies the newly created office of chairman of the board. **M. H. Pendergast,** executive vice president and general manager, has taken over the presidency, and **J. P. McCarthy,** director of manufacturing in the Ohio division for the last 11 years, is now vice president in charge of manufacturing in all plants.

E. R. Traxler, of the industrial products division, **B. F. Goodrich Co.,** Akron, Ohio, is now managing the new flat belting field engineering and development department. He has been engaged in product development for the company since 1935. . . . **Hall Laboratories, Inc.,** Pittsburgh consulting firm on industrial and municipal water problems, has appointed **Joseph M. Maloney** to its research department. A chemical engineer, he will specialize on problems of condensate line corrosion and its control.

In the area west of the Cascade mountains and including northern Idaho, **John L. Harvey Co.,** 310 Radio Central Bldg., Spokane, Wash., is representing the roof ventilator division of **Swartwout Co.,** Cleveland. . . . **Air Reduction Sales Co.,** New York, has transferred **J. B. Davenport,** assistant manager of the Detroit district, to the Charlotte, N. C., district where he is assistant manager. He has been succeeded in Detroit by **J. H. Hart,** former assistant sales manager in that office, and **R. A. Jamieson** has taken over Mr. Hart's former post. **A. S. Blodget, Jr.,** has been named assistant manager of the Boston district.

Matthew J. Delehaunty, a veteran of 27 years of service with the company, is the new Pittsburgh district sales manager of the mechanical goods division, **United States Rubber Co.,** New York. He has been a salesman for the division, with headquarters in Pittsburgh, since 1937 and now succeeds **J. W. Greenwalt** who has retired from the company. . . . **Timken Silent Automatic Div., Timken-Detroit Axle Co.,** Jackson, Mich., has appointed **Gaylord W. Schultz** middle west regional manager and **James H. Eldridge** as district sales manager. Mr. Schulz will make



Third Floor Installation MADE PRACTICAL ...by KORFUND

Locating air conditioning equipment anywhere above the ground floor presents problems, mainly because of excessive vibration and noise in operation. Korfund Standard Vibro-Isolator Units have solved this problem many times.

For example, Valley Weathermakers, Harlingen, Texas, recently installed a reciprocating compressor on the third floor of S. H. Kress & Co. building, Brownsville, Texas. In this instance, installation was made even more difficult by location near the offices and sales floor. Yet today the 2300 lb. compressor and 900 lb., 40 HP motor are operating satisfactorily mounted on four Korfund LK/F Vibro-Isolators. Valley Weathermakers' letter states:

> "... These isolators are doing an excellent job of removing vibration caused by the motor and compressor. You can stand in the office directly below the equipment and not be able to tell whether or not (it) is in operation ... The Construction Superintendent for S. H. Kress & Co. .... was very much pleased ... (In another case) we have an air conditioning compressor installed on the second floor of an office building, and it is disturbing the tenants below. From the results of the Brownsville, Texas, job, we feel sure that your Isolators will remedy the trouble on this installation."

It is interesting to note that more than 75% of Korfund orders in the air conditioning field are *repeat* business. We'll be glad to send further details showing why this is so. Write us today about your problems in Vibration Control.

KORFUND VIBRATION CONTROL

The **KORFUND Company, Inc.**

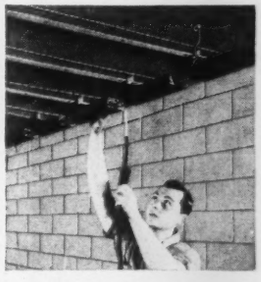
48-01-F Thirty-Second Place
Long Island City 1, N. Y.
Specialists in
Vibration Control for Over 45 Years
Representatives in Principal Cities

INVISIBLE RADIANT HEATING

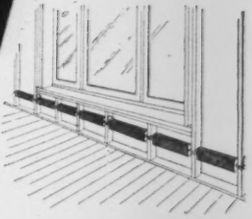
KRITZER "FIN-TUBE" RADIANT COILS

for the NEW economical
RADIANT HEATING!

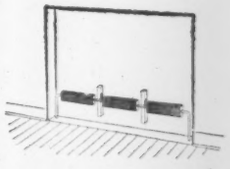
Thousands of installations have now proved the amazing advantages of Kritzer Radiant Coils from the important standpoint of heat transfer and especially the practical economy of both materials and labor. For better installations, for more profits, GET THE FACTS!



Joining coil sections with torch and solder ring. No threading. No fitting.



"Fin-Tube" panel heating in picture window wall.



Kritzer Radiant Coils in recessed chamber for panel heating.

A finished heating section on Kritzer hangers. Joists furred and ready for lath and plaster.

FOR JOISTS AND STUDS 12"—16" OR 24" O.C.

CONVENIENT LENGTHS

SIMPLE • TIME-SAVING DOLLAR-SAVING

A single Kritzer Radiant Coil supplants several lengths of ordinary tubing. These coils are a single ⅝" copper tube with mechanically bonded 1½" x 3" aluminum fins, ¼" apart. Here is efficient heat transfer with first cost the last cost. WRITE TODAY and send the coupon.

IF IT'S KRITZER, IT'S RIGHT SIR

NEW DESCRIPTIVE FOLDER AVAILABLE

KRITZER RADIANT COILS, INC.
2905 West Lawrence Avenue, Chicago 25, Illinois

Gentlemen: I'm interested. Please send complete information and bulletin on KRITZER "Fin-Tube" Radiant Coils.

Name_____
Firm_____
Address_____
City_____ Zone_____ State_____

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Thermobloc

DIRECT-FIRED UNIT HEATER

Advanced

DESIGN

Automatic

CONTROL

Inexpensive

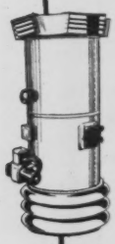
OPERATION

There is no unit heater on the market with the simplified, direct transfer design found in THERMOBLOC.

Complete automatic control offers a safety factor and saves cost of an operator.

Direct transfer of heat from the products of combustion to the air without an intermediary, utilizes every possible heat unit in the fuel, with the amazing results of 82-86% efficiency with No. 3 oil or gas.

Immediately available in two sizes:



THERMOBLOC 300

300,000 b.t.u.'s, only 7' high, weight 800 lbs.

THERMOBLOC 550

550,000 b.t.u.'s, 10' high, 30" diameter, weight 1200 lbs.

THERMOBLOC DIVISION

PRAT-DANIEL CORP.

Manufacturers of the well known Thermix Power Plant Equipment

70 WATER ST., E. PORT CHESTER, CONN.

Gentlemen: Please send me your technical bulletin on THERMOBLOC applications.

Name_____ Title_____

Company_____

Address_____

his headquarters in Kenosha, Wis., and will be responsible for the northwest region. Mr. Eldridge, formerly with Herndon Sales and Service, a Chicago distributor of the company, will have the territory of North and South Dakota and portions of Iowa and Minnesota.

Jack C. Burns, with offices in the Terminal Sales Bldg., Seattle, is handling the sale of brass goods, water tube, and pipe in the Pacific northwest as representative for **Bridgeport Brass Co.,** Bridgeport, Conn. . . . **S. B. Withington,** general manager since December 1948 of the Lycoming-Spencer division, Williamsport, Pa., has been elected a vice president of **Avco Mfg. Corp.** The **Spencer Heater Division** has appointed **Michael L. Lavorgna, Inc.,** Milwaukee, sales agent for the state of Wisconsin. . . . As representative for **Chicago Nipple Mfg. Co., Robert Liles,** Box 488 New Orleans 1, is covering the states of Louisiana and Mississippi.

Representation of the heating specialties of **Radiator Specialty Co.,** Charlotte, N. C., is being handled in northern and western New York by **Frank W. Lake** who will make his headquarters in Buffalo. **Dallas W. Shoemake** represents the firm in the northern half of California, and **Leo R. Peloquin** is covering western Pennsylvania and eastern Ohio as district manager. **P. P. Moeszinger** is handling representation in southeast Pennsylvania, southern New Jersey, Delaware, and the eastern shore of Maryland. . . . **Walter Sormane,** La Salle, Ill., has resigned as general sales manager of **Conco Engineering Works,** Mendota, Ill., with whom he has been associated since 1944. He is well known in the heating industry in which he has spent 20 years and was previously sales manager of the heating division, Schwitzer-Cummins Co.

L. B. Dobbins, Air Reduction Sales Co., New York, is now supervising plant engineering matters not assigned to the company's general engineering division. Formerly superintendent of the Johnstown tonnage oxygen plant, he is also the liaison between the operating, engineering and research departments. His former position has been taken over by **J. C. White** superintendent of the Gloucester, N. J., oxygen plant. . . . The **Chicago Technical Societies Council** is made up of some 50 scientific, engineering, and technological societies. Its new president, **R. H. Bacon,** is vice president of Kreicker & Meloan, Inc., industrial advertising agency, and president of R. H. Bacon & Co., a business paper editorial service organization.

Chicago Nipple Mfg. Co., Chicago, has appointed **Carl H. Roath Co.,** 1440 11th St., Denver, representative in Colorado, Wyoming, New Mexico, the five western counties of Nebraska, and the city of El Paso, Tex. . . . **Frank Ross,** national manager of lubrication since 1944 for **E. F. Houghton & Co.,** Philadelphia, has been appointed to the newly created post of assistant to the vice president—sales. He retains his duties and title as head of the lubrication department and has moved from Cleveland to the home office. . . . **Allen-Lagarde Co.,** with offices in Houston and Fort Worth, has represented the D. T. Williams Valve Co. for 20 years. The firm has been redesignated to continue as sales representative for the **Williams Valve Div., Schaible Co.,** Cincinnati.

CASE REPORT No. 55 from a series of actual cases recording the successful application of "BEAR" DY-NAMIC BALANCING to Industry.

DY-NAMIC BALANCING

is a plant maintenance operation that

Reduces Mechanical Failures!

ELECTRICAL MAINTENANCE CO., INC.,

Boston, Mass., reports that several years ago "we installed a 'BEAR' Dy-Namic Balancing Machine Model 375-R as a customer service for the balancing of rotors, armatures and other rotating parts of motors and machinery. Previously, we had balanced rotating parts only statically, but 'BEAR' Dy-Namic Balancing has proven itself more successful with us. The reasons for this are (1) that motors with Dy-Namically Balanced rotating parts have longer life, operate more smoothly and (2) that the consequent increased bearing life reduces the number of mechanical failures experienced by our customers."

Motors with DY-NAMICALLY BALANCED Rotating Parts

✓ Last Longer
✓ Operate More Smoothly
✓ Promote Increased Bearing Life

Experience proves that when "BEAR" Dy-Namic Balancing is made an integral part of plant maintenance operations, it CUTS OPERATING COSTS and IMPROVES PLANT MAINTENANCE! Experience also proves that the old way of *only Statically Balancing* rotating parts *is not enough!* Only a *combination* of both Static and DY-NAMIC BALANCING—which is attained with the body *in motion*—eliminates excessive vibration, premature wear and noisy operation to a point where it actually REDUCES MECHANICAL FAILURES!

"BEAR" Balancing Machines, themselves, are practically "custom-made" for plant maintenance work! Their universality makes possible an almost *unrestricted range of applications,* so necessary in most maintenance operations. Furthermore, the "BEAR" Method attains both Static and Dy-Namic Balance in *one* precision operation!

You can install a "BEAR" Balancer without fear of having to hire highly-paid, technically-trained operators or investing a lot of money in the machine itself!

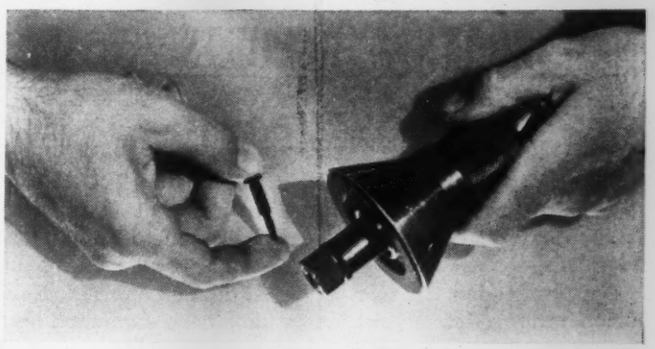
FREE DY-NAMIC BALANCING MANUAL

tells all about this revolutionary method for plant maintenance, as well as production applications. **GET YOUR COPY TODAY!** Bear Mfg. Co., Dept. H-16, Rock Island, Ill.

"BEAR"

Trade Mark Registered U. S. Patent Office

STATIC AND DY-NAMIC BALANCING MACHINES



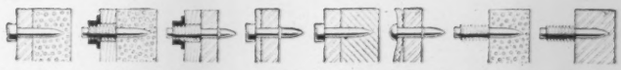
$2,122.00 SAVED

with Ramset FASTENING SYSTEM

A $70 investment in a RAMSET TOOL saved this contractor (name on request) $2,122 *on just one job.* Cost of setting 7,118 fasteners by drilling and tapping would have been $4,742 (plus material). With the RAMSET SYSTEM, the total cost for material and labor was $2,620—saving $2,122 or 44.7%. All for a $70 investment!

SPLIT-SECOND FASTENING WITH RAMSET

No matter how large or how small your fastening jobs, you do them better, quicker, cheaper the RAMSET way. The light, portable tool takes only 30 seconds to load. No electric or air lines—it's self-powered. Press it against the work and RAM—the job is done. So simple and easy that we can teach any good workman, in an hour, to "RAMSET" jobs like these:



LET US ANALYZE YOUR FASTENING COSTS

Ask for 15-minute demonstration of RAMSET SYSTEM. We'll show you how you can do your work faster, better and at amazingly lower cost. No obligation—just mail the coupon for details. *Stemco Corporation, Cleveland 16, Ohio.*

MAIL THIS COUPON

Stemco Corporation,
Cleveland 16, Ohio

Please send details and arrange for demonstration of RAMSET FASTENING SYSTEM and how it will save time and cut our costs. HP

Name_____

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NEW BOOKS & REPORTS

ASRE Data Book Covers Refrigeration Fundamentals

The new 6th edition of the ASRE Data Book (Basic Volume), prepared under the direction of Prof. Burgess H. Jennings as editor-in-chief and his staff of editors, has been largely rewritten and the tabular matter has been greatly extended to cover the latest data on fundamentals of operation. Refrigerant tables have been expanded and recomputed to give more convenience in their use, particularly in the superheated vapor range, and a number of charts covering the newer refrigerants have been added. Analyses of refrigerating equipment range from domestic units to the large size centrifugals, and new compilations of data on insulation and heat transfer coefficients are included.

Of the previous data books, only in those of 1940 and 1946 was no attempt made to include the whole field of refrigeration in a single volume. Fundamental data were included in the edition of 1943 but without emphasis on applications, whereas the 1946 edition was primarily an applications volume. The new edition again covers basic data, fundamental principles, and practices, and it is the intention of the society to issue future revisions biennially in odd numbered years. The applications volume is in its second edition and revisions of it will appear in even numbered years.

Containing over 900 pages, 233 tables, and 362 illustrations, the clothbound text may be obtained from the American Society of Refrigerating Engineers, 40 W. 40th St., New York 18. The price is $7.00 in this country, $7.50 elsewhere.

Handbook Gives Data on Pumps, Turbines, Compressors, and Gears

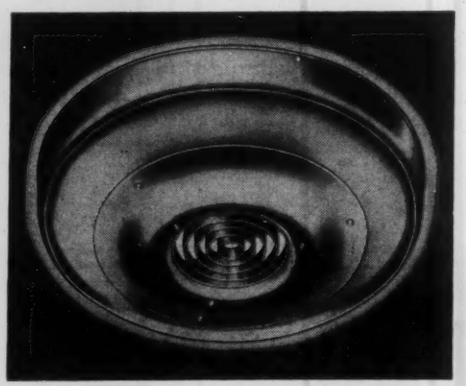
A new edition of the handbook prepared by De Laval Steam Turbine Co. contains reference data, information, and formulas for the design, installation, and operation of steam turbines, centrifugal and positive displacement pumps, compressors, blowers, and exhausters, and helical and worm type reduction gears.

Compiled by the company engineering staff and edited by Austin H. Church and Hans Gartmann, the volume is just what its name implies, an Engineering Handbook containing a good deal of data arranged in orderly fashion. Not the least important is the general section which covers the first 100 odd pages. Tables and charts are used to provide basic data on mathematics, mechanics, fluids, and electric motors.

Copies of the 5½ x 8 in. clothbound volume are available from the company's advertising department, Trenton 2, N. J., for $2.00.

Heating and Ventilating in Airliner Based on Mock-Up Tests

Many studies have been made and numerous articles have been written on the subject of designing aircraft cabin conditioning systems for passenger comfort. In the paper Heating and Ventilating of the Martin 202 Airliner, Robert L. Berner, design specialist, Glenn L. Martin Co.,



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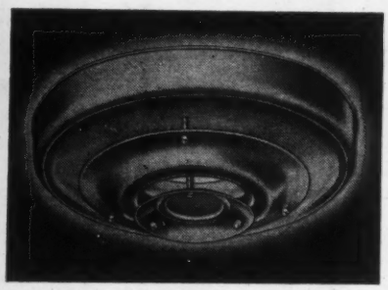

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● The problem of ceiling discoloration has been effectively minimized by the development of Type "SE" FUSEAIR. The extended moulding design-feature of this unit will assure your customers a tremendous saving in redecorating costs.

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UP TO 42,000 CFM!

BY REMOVING DOOR, EASY ACCESS IS OBTAINED TO FAN, SHAFT AND MOTOR.

New DeBOTHEZAT Power-Flow ROOF VENTILATORS with 42" and 48" FAN WHEELS

HEAD REMOVED TO SHOW FAN WHEEL

POSITIVE, CONTROLLED VENTILATION at all times!

DeBothezat Power-Flow Roof Ventilators are available in a full range of sizes, including the new 42" and 48" models. Power-Flow — a motor driven fan mounted in a weather-proof housing — provides controlled ventilation at all times regardless of weather. These rugged, efficient ventilators exhaust more air per brake horsepower than other ventilators. Non-overloading power characteristic prevents motor burn-out. May be used with or without duct system.

LOW, STREAMLINED DESIGN

Blending well with modern architecture, DeBothezat Power-Flow Roof Ventilators are available in sizes from 16" through 48", delivering from 990 through 42,000 CFM! *Write today for complete details and prices.*

DeBOTHEZAT FANS DIVISION
American Machine and Metals, Inc.
Dept. H-9,
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SAVE

Steam $$$...Cut Processing and Heating Costs with

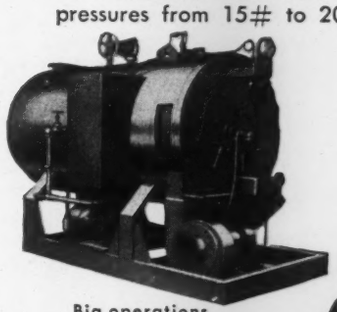
AMESTEAM GENERATOR

Amesteam users Report Big Savings in Time, Costs and Cleanliness...

"We have cheaper steam, quicker steam and cleaner steam since we installed an AMESTEAM Generator," says one satisfied AMESTEAM user.*

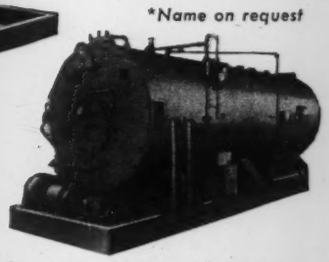
He's typical of the many hundreds who have discovered the advantages of the AMESTEAM Generator push-button system over wasteful, hand-fired boilers. Full steam in a few minutes — clean, dustless operation — no ashes — no waste.

Available in sizes from 10 h.p. to 400 h.p. in pressures from 15# to 200#.



Where requirements are small — this 10 h.p. AMESTEAM Generator for light oil firing gives you the same automatic and efficient operation as the largest unit.

**Name on request*



Big operations are handled quickly, cleanly, efficiently, inexpensively with a 400 h.p. AMESTEAM Generator. Unit shown is for heavy oil firing.

AMES Iron Works, Oswego, N.Y.

AMES IRON WORKS
Box 2009
Oswego, New York, U.S.A.

We would like to learn more about the AMESTEAM Generators. Please send bulletin.

Name.....
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Address.....
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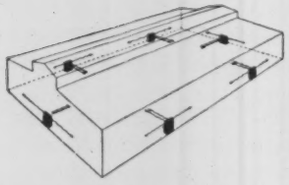
MAIL THIS COUPON TODAY!

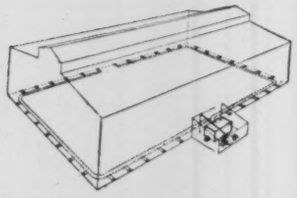
Direct Fired

WARM AIR HEATERS* by LEE

**a COMPLETE line for every application*



One or more heaters is placed inside of the space to be heated.

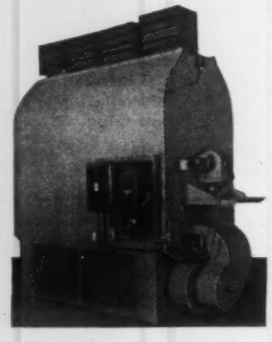


Heater is placed in a central location, warm air being delivered by ducts to space heated.

Whatever your needs in large scale heating you will find a Lee Direct Fired Unit to handle the job efficiently and economically. Over thirty years of experience in building quality heaters guarantees the proper unit for the job whether you contemplate a unit or central system. Illustrated at left are the two types mentioned — the top diagram shows an installation using one or more heaters in which capacities from 300,000 to 6 million Btu may be obtained. The bottom diagram illustrates the central system in which the heated air is distributed through ducts in which 3 million to 8 million Btu may be developed.

The efficiency of the Lee counter-current flow reduces fuel consumption; while the rugged simplicity of the system decreases cost of installation, assures low maintenance charges, and also provides ventilation without additional cost. In addition to normal heating installations Lee Direct Fired Units may also be used for drying and curing in cases where these two operations are required.

It will pay you to investigate the Lee line today—literature is available describing completely the principal types of construction and versatility of operation as well as a partial list of prominent and satisfied Lee customers.



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brings to light some of the practical problems encountered in applying established principles.

The heating and ventilating system in this plane consists essentially of a 200,000 Btu per hr gasoline fired heater, a main ventilating fan, a combustion air fan, the cabin booster fan, and a fresh air fan, together with a fuel system, operational and temperature controls, and the air distribution system. The present arrangement is the result of an extensive research program involving a study of existing systems in planes, trains, and buses. In addition, a full scale cabin mock-up was heated and ventilated, and during two simulated "flights" 40 occupants were asked to note their reactions.

After describing the design features which were dictated by these tests, the author outlines the system as it was installed in the plane and then covers several major faults (together with corrective measures) which were uncovered after the plane was in service. A good deal of space is devoted to operational temperature, safety, and special and emergency controls.

Presented at the recent spring meeting of the American Society of Mechanical Engineers, the paper is identified as No. 49—S-9. Copies may be obtained from ASME headquarters, 29 W. 39th St., New York 18.

Other Books and Reports Received

Heat Transfer, Vol. 1, by Max Jacob, research professor of mechanical engineering, Illinois Institute of Technology—Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, 758 pp., 251 illus., 6 x 9¼ in., $12.00. An unusually complete treatment of convection and conduction together with two chapters on radiation. To be reviewed.

The Heat Pump, by J. B. Pinkerton, consulting engineer—Published by Princes Press Ltd., 147 Victoria St., Westminster, London S.W. 1, 250 pp., 100 illus., $5.00. Includes illustrations and data on European installations.

Studies in Air Hygiene, Medical Research Council Special Report 262—Available from British Information Services, 30 Rockefeller Plaza, New York 20, 356 pp., $2.35. Published by the British Medical Research Council and prepared by a study group which specialized on this subject during the war, the report includes material on the techniques for reducing bacterial contamination through the use of filters, ventilating equipment, and chemical sprays.

Welding and Cutting Manual—Published by Linde Air Products Co., Unit of Union Carbide and Carbon Corp., 30 E. 42nd St., New York City, 208 clothbound pages, 6 x 9 in., $1.80. This is a handbook on the oxyacetylene process which gives simple and easy-to-read instructions. It is prepared especially for repairmen, mechanics, and maintenance men but will help any welding operator do a better job. Included are short cuts and instructions for bronze and fusion welding, soldering, hard facing, cutting steel and cast iron, heating, forming, straightening, welding and cutting pipe, and welding nonferrous metals. The appendix contains useful tables and charts and a glossary of welding terms.

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THE LOWDOWN ON INSULATION

Easy does it

Some low-temperature insulation materials are contrary as a mule. It's a major effort to get them properly into place and sealed against moisture.

Novoid Corkboard is different. Novoid is not only efficient—it actually helps the job along.

To start with, Novoid is light in weight—easy to handle. It's strong and solid, so you don't have to waste time trying to keep it from packing down or leaking out. It's flexible—fits over slight irregularities of surface without special shaping—doesn't crumble if it's unevenly loaded. Since Novoid Corkboard is cellular, it doesn't soak up moisture; and the vaporproofing job is simple.

Every one of these factors saves labor time, and that saves money for you. When you're planning an insulation job, it pays to call in a Novoid contractor. We'll be glad to furnish names. Novoid Cork, Englewood, N. J.

Consider EVERY factor when you buy insulation—and you'll buy NOVOID

Check list of insulation properties

	Novoid Cork Insulation	Many Other Insulations
First cost	moderate	low to high
Installation cost	low	moderate to expensive
Eventual cost	low	high
Efficiency	remains high	generally deteriorates
Moisture resistance	excellent	some good, some poor
Vapor seal	simple	complicated or difficult to install
Structural strength	very good	some non-existent, others fair
Weight	very light	varies
Resilience	considerable	from fair to complete rigidity
Settling	none	a serious problem
Supporting structure	none	elaborate
Fire resistance	good	excellent to poor
Vermin resistance	good	excellent to very bad
Odor absorption	none	some are regular sponges

hot water in a hurry!

Where sudden hot water pulls—or an unpredictable time schedule—are in the order of things, install

Paracoil INSTANTANEOUS WATER HEATERS

TO KEEP PACE WITH THE LOAD—ALL THE WAY!

No storage tank is necessary—they have enough, and more, heating surface built into them to heat the water as fast as it is drawn! Thousands in use.

If you have such a problem, we have the answer! Stock designs permit quick deliveries..at prices lower than you think!

Write today for a copy of our new Bulletin 70 Section I, describing this line of Paracoil Water Heaters.

◀ This bulletin, in addition to tables of capacities and physical dimensions on our U-Tube designs, contains a wealth of practical, worthwhile engineering data on how to size, figure steam requirements, and pipe up PARACOIL INSTANTANEOUS WATER HEATERS. YOUR COPY AWAITS YOU!

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AGENTS IN PRINCIPAL CITIES

MEETINGS & CONVENTIONS

Instrument Society of America, 921 Ridge Ave., Pittsburgh 12—The 4th annual conference and exhibit, September 12 to 16, Municipal Auditorium, St. Louis. A preconvention instrument maintenance clinic will be held September 9, 10, and 11 at the Statler hotel.

It is expected that over 12,000 persons will attend the exhibit and over 300 instrument men will participate in the clinic. The technical program of the convention will consist of 75 papers presented in 26 sessions. The ISA will have a total of 13 sessions; the National Telemetering Forum, four sessions; the American Institute of Physics, three sessions; the American Society of Mechanical Engineers, industrial instruments and regulators division, three sessions; the American Institute of Electrical Engineers, instruments and measurements committee, three sessions.

Corrosion Short Course—To be held September 12 to 16, University of Texas, Austin, and sponsored by the National Association of Corrosion Engineers, 919 Milam Bldg., Houston 2. The course, designed as a refresher in the fundamental phenomena with which the corrosion of metals is concerned, will consist of nine two hour lectures followed by discussion periods.

Lectures and speakers scheduled are:

Metallurgy—F. A. Prange, Phillips Petroleum Co.
Corrosion Resistant Metals—Frank LaQue, International Nickel Co.
Practical Aspects of Cathodic Protection—A. W. Peabody, Ebasco Services, Inc.
Theoretical Aspects of Cathodic Protection—Scott P. Ewing, Carter Oil Co.
Types of Corrosion—L. G. Vande Bogart, Crane Co.
Fundamentals—Dr. Norman Hackerman, University of Texas

Application for official registration blanks should be sent to A. B. Campbell, executive secretary of NACE. The fee is $20.00 and applications are limited to 250.

National Association of Corrosion Engineers, 919 Milam Bldg., Houston 2—South central regional meeting, Adolphus hotel, Dallas, Tex., October 3 and 4. Eight technical papers, a panel discussion, and various committee meetings are planned. Among the technical papers is one on selection of protective coatings for fume resistance by C. C. Harvey, Ethyl Corp. Another by W. H. Crenshaw, American Inspection Service, deals with internal corrosion of crude oil tanks, and Oliver Osborn, Dow Chemical Co., will discuss the combating of corrosion in chemical plants with magnesium anodes. Application of magnesium anodes to pipe line protection will be the subject of a paper by J. A. Holloway, Houston Pipe Line Co.

American Society for Testing Materials, 1916 Race St., Philadelphia 3—First Pacific area national meeting, Fairmont Hotel, San Francisco, October 10 to 14. Several technical committees will hold sessions and some 70 technical papers will be presented. Subjects to be dealt with include plasticity and fatigue of metals, dynamic stress determinations, high additive content oils, and turbine oils.

Air Conditioning School for Maintenance Men—The Bahnson Co., 1001 S. Marshall St., Winston-Salem, N. C.,

COMPARE THESE FEATURES . .

✓OLSON Has Them All

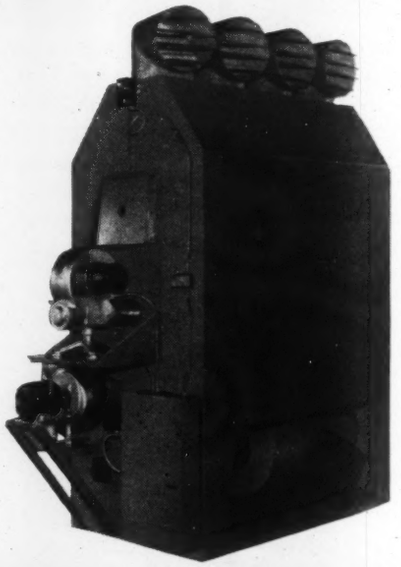
✓ COMFORT — No cold blast. Blower fan does not circulate air until air is raised to proper temperature.

✓ ECONOMY — Low first cost. High efficiency—80 to 85 per cent. Durable, long lasting construction.

✓ FLEXIBILITY — On dual fuel installations change from gas to oil by the flip of a switch.

✓ EASY MAINTENANCE — Cleaning of entire unit and maintenance or replacement of all vital parts accomplished without dismantling the unit.

✓ SAFETY — Completely equipped with vital safety controls. Unit will pass requirements of any insurance company.



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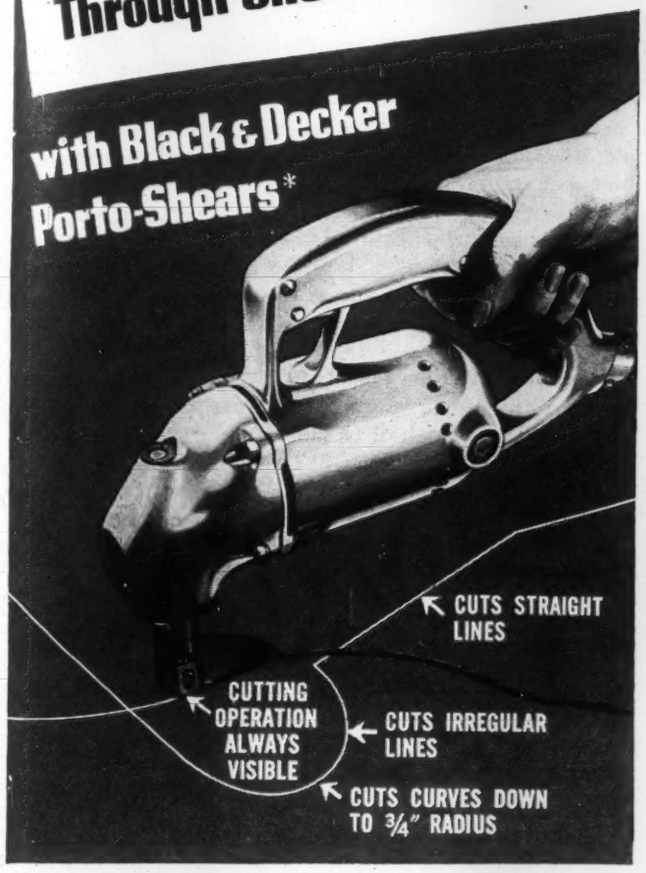
ZIP Through Sheet Metal Work

with Black & Decker Porto-Shears*



Black & Decker Electric Porto-Shears cut sheet metal too tough for snips, speed up jobs where snips are slow. Fast, powerful shearing action eliminates hard muscular strain. New 12-gage unit has been developed to increase the range of the Porto-Shear line to heavier materials. Over-all design simplicity is retained with heavier construction necessary to shear 12-gage steel. Also shears about two gages thinner in Monel and stainless; 50% above rating in sheet copper, aluminum, lead, etc. Other models include 16- and 18-gage Porto-Shears.

For full information on Porto-Shears and many other speedy Electric Tools, see your nearby B&D Distributor. Write for free catalog to: The Black & Decker Mfg. Co., 628 Pennsylvania Ave., Towson 4, Maryland.

*Trade Mark Reg. U. S. Pat. Off.

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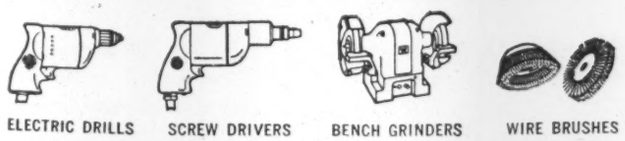
PORTABLE ELECTRIC TOOLS



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GREAT NORTHERN RAILWAY INSULATES UNDERGROUND PIPES WITH Z-CRETE*

modern system provides insulation that is

another "Z"crete success story

Four separate installations by Great Northern Railway are in themselves an endorsement of Z-crete's efficiency, economy, and ease of application.

Extra Efficiency and Protection

Z-crete Underground Pipe Insulation keeps heat *in the system,* as no other method does. No joints or cracks to leak heat, complete moisture-free protection.

Low-In-Cost—Permanent

Furnished and installed by competent applicators, Z-crete is less costly to install—it's permanent and there's no maintenance. Won't get out of line, deteriorate, crack or crumble. Easily removed to repair pipes—ideal for reinsulating existing conduits. Send coupon below for complete information.

Z-CRETE DIVISION

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MAIL COUPON FOR FULL DETAILS

Zonolite Company—Dept. HP-99
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Please send me complete work sheets about Z-crete for underground pipe insulation.

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*Z-crete is the registered trade mark of Zonolite Company, Chicago 3, Ill.

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It's nice to have

VULCAN

"around the house"

For most homes and residential units Vulcan Baseboard "Radi-vector" installed along the outside or exposed walls ***only,*** provides the most luxurious kind of heat available — ***radiant heat*** for floor level comfort, ***convection heat*** for even comfortable temperatures from floor to ceiling. The reason is that "Radi-vector" is a continuous line, fin-on-tube type of radiation. Fins extend the heating surface of tube yet allow the installation to remain so compact that it takes up little more space than a conventional wooden baseboard.

Attractive Covers

"Radi-vector" FS Cover is specially designed for improved performance and decorative appeal. "You feel the warmth—you have to look for its source."

Easy to Install

Used in either hot water or two-pipe steam systems, Radi-vector comes cut to length, requires few fittings and supports, is as easy to install as a length of pipe.

For details ask your nearest Representative for Bulletin No. 52.

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will again conduct two one-week terms of classes for maintenance engineers on industrial air conditioning. Starting October 10 and 17, courses will duplicate each other. Lectures and inspection trips will cover a wide range of subjects and talks will be given by engineers affiliated with various equipment manufacturers.

American Standards Association, 70 E. 45th St., New York 17—The 31st annual meeting, October 11 to 14, Waldorf-Astoria hotel, New York City. Meetings of various committees, the standards council, and the board of directors are scheduled. Also planned is a company member conference and reports on international developments in standardization. Karl T. Compton, chairman, Massachusetts Institute of Technology, and chairman, research and development board of the National Military Establishment, will speak at the annual luncheon meeting, October 14.

American Welding Society, 33 W. 39th St., New York 18—The 30th annual meeting and exposition will be held in Cleveland, the week of October 16.

As usual, the meeting will be held during the National Metal Congress and Exposition. The society has reserved a block of rooms at the Hotel Cleveland, headquarters for the meeting. Additional room applications will be referred to the Metal Congress Housing Bureau.

The 37th National Safety Congress and Exposition, October 24 to 28, Chicago. Sessions on industrial safety are scheduled for the Stevens, Congress, and Morrison hotels. Further information can be obtained from R. L. Forney, general secretary, National Safety Council, 20 N. Wacker Dr., Chicago 6.

2nd Biennial Pacific Chemical Exposition, November 1 to 5, San Francisco Civic Auditorium—A display of natural resources of the 11 western states is to be a featured exhibit at the show which is sponsored by the California Section, American Chemical Society. Whitcomb hotel, San Francisco 1. Marcus W. Hinson is managing the affair.

During the affair, a number of one and two day conferences will be held by various organizations including the American Institute of Chemical Engineers, northern California section, the northern California rubber group, petroleum division, American Chemical Society, California section, and the Society of the Plastics Industry, San Francisco section.

Ninth Midwest Engineering and Power Exposition—November 11 to 16, Navy Pier, Chicago. George E. Pfisterer, 308 W. Washington St., Chicago, is managing director.

Sixth All-Industry Refrigeration and Air Conditioning Exposition, 1346 Connecticut Ave., Washington 6, D. C.—November 14 to 18, Atlantic City Auditorium, sponsored by the Refrigeration Equipment Manufacturers Association. Over 5000 rooms have been pledged by nearby hotels and approximately 75,000 sq ft of exhibition space will be used. Headquarters for cooperating associations are: Traymore hotel, REMA and exhibitors; Claridge hotel, Refrigeration Equipment Wholesalers Association; Ambassador hotel, Refrigeration Service

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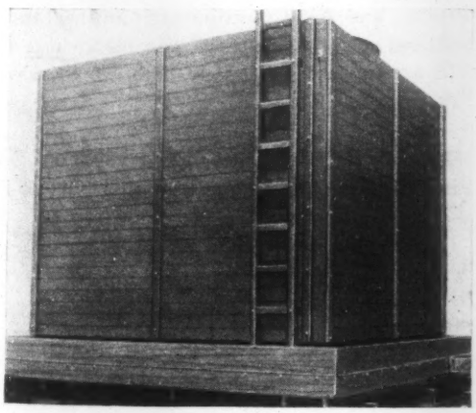

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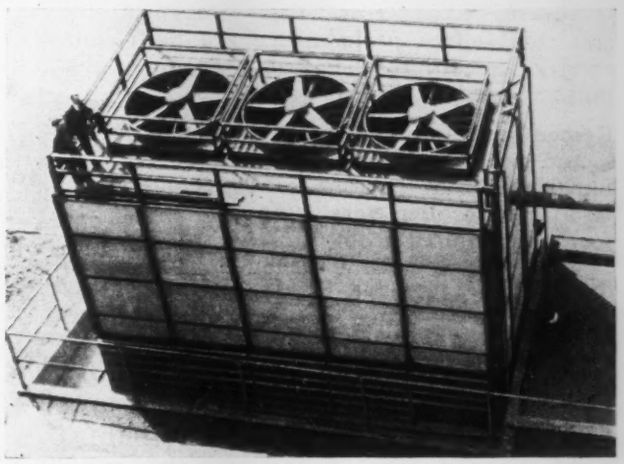

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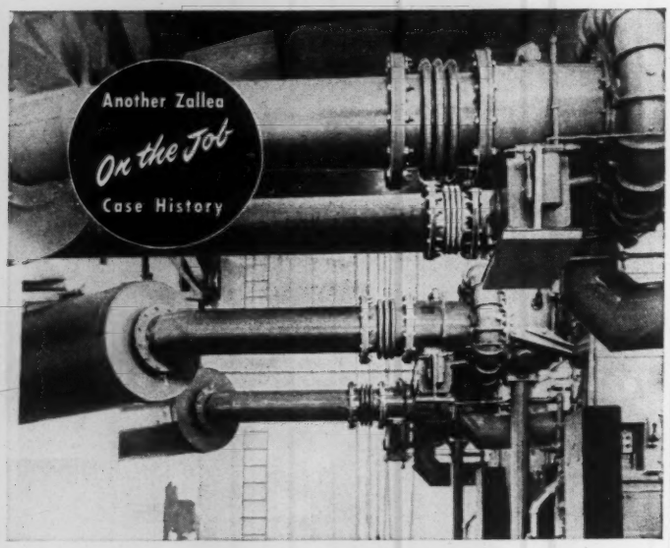

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The exposition will be open exclusively to service engineers and contractors on the first day, November 14.

American Society of Refrigerating Engineers, 40 W. 40th St., New York 18—1949 annual meeting, December 5 to 7, Edgewater Beach hotel, Chicago.

Plant Maintenance Exposition and Conference, January 16 to 19, Cleveland Auditorium—Exhibits and conference subjects will deal with air conditioning, heating, ventilating, building supplies, electrical equipment, employee relations, instruments, lubricants, paints, materials handling, power generation and transmission, welding, etc. A 15-man board of leading industrialists and editors is acting as an advisory group. Advance registration cards and hotel information may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, exposition manager.

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York 10—56th annual meeting, Adolphus and Baker hotels, Dallas, Tex., January 23 to 26.

Southwest Air Conditioning Exposition of the International Heating & Ventilating Exposition—State Fair Grounds, Dallas, Tex., January 23 to 27. As in past years, the show will be managed by International Exposition Co., Grand Central Palace, New York City, and will be held under the auspices of the American Society of Heating and Ventilating Engineers which is represented by an advisory committee headed by A. E. Stacey, Jr., president of ASHVE. The show is expected to fill the Hall of Agriculture and the Poultry Building.

National Association of Corrosion Engineers, 919 Milam Bldg., Houston 2—The 6th annual conference, St. Louis, April 4 to 7. Symposia under consideration include round table discussions on general corrosion problems and corrosion in connection with pipe lines, refrigeration and air conditioning, and the food industry.

Heating, Piping, and Air Conditioning Contractors National Association, 1250 Avenue of the Americas, New York 20—1950 annual meeting, May 8 to 12, St. Francis hotel, San Francisco.

National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6—The 41st annual meeting, Grove Park Inn, Asheville, N. C., May 23 to 26.

IBR Issues Ratings for Cast Iron Boilers

A new edition of IBR Ratings for Cast Iron Boilers has been published by the Institute of Boiler and Radiator Manufacturers, 60 E. 42nd St., New York 17. Priced at 50 cents, it contains ratings for low pressure boilers currently offered by 18 manufacturers.

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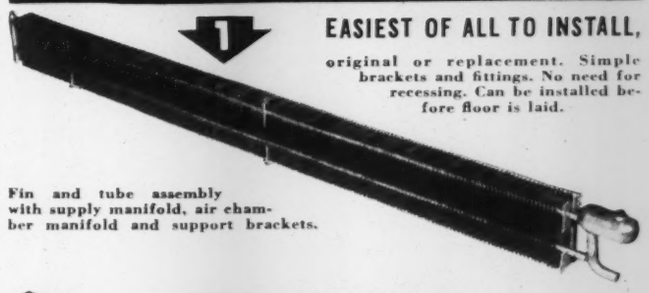

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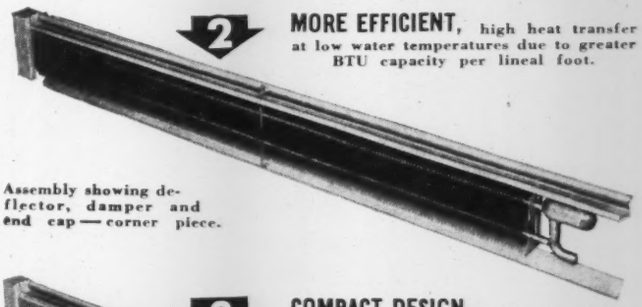

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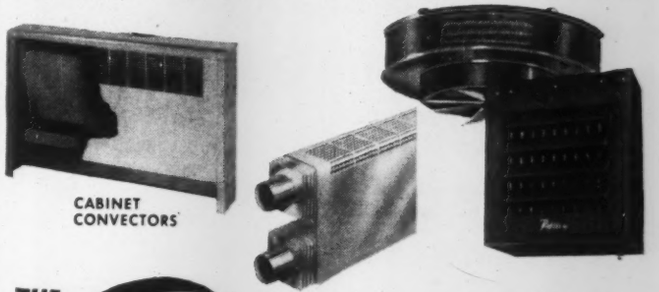

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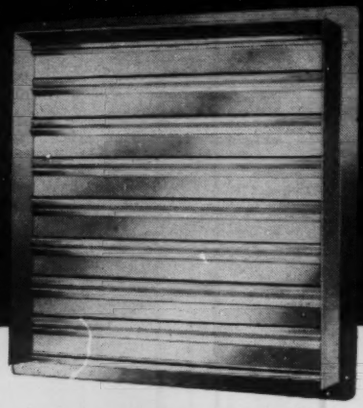

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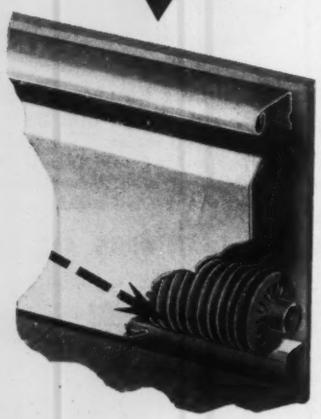

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No. 7388: Air and Oil Filters—A new eight page general catalog released by Air-Maze Corp., 5200 Harvard Ave., Cleveland 5, covers all-metal washable air filters and water eliminators, electostatic air filters, oil bath type air filters for intakes of engines, compressors, and pressure blowers, oil wetted filters, air intake silencers, oil and fuel filters, pipe line filters, backfire and tank vent flame arrestors, and both screen and electrostatic types of oil separators.

No. 7389: Aluminum Extruded Shapes—In order to explain the advantages of aluminum extrusions, Reynolds Metals Co., Aluminum Div., 2500 S. Third St., Louisville 1, Ky., has isued a four page booklet covering various applications. A description of how shapes are produced is given and how special shapes to fit particular needs may be designed. Information is also given on commercial tolerances, mechanical properties, chemical compositions, etc.

No. 7390: Arc Welding—Bulletin 462, "Weldirectory" for Mild Steel and Low Alloy, High Tensile Steels, has been issued by Lincoln Electric Co., Cleveland 1. Electrode selection charts, information and procedure pointers on shielded arc welding, and detailed information on recommended electrodes are included.

No. 7391: Cocks, Valves, and Swing Joints—A wide variety of cocks, including gas cocks, three- and four-way cocks, and other special types are described and illustrated in Bulletin 100-1 of Minneapolis-Honeywell Regulator Co., Belfield Valve Division, Philadelphia 44. Also featured are check valves, stop valves, stop and check valves, transfer valves, and swing joints.

No. 7392: Control Systems for Hot Water and Radiant Heating—Sarcotherm Controls, Inc., Empire State Bldg., New York City, has prepared a 12 page technical bulletin (No. 2) dealing with centralized, panel program control systems for hot water and radiant heating. Schematic diagrams of boiler hookups and wiring diagrams are included, illustrating control systems for apartments, offices, schools, institutions, etc.

No. 7393: Crane Cab Air Conditioning—Bulletin 1300, describing air conditioning systems for crane cabs operating in hot or contaminated atmospheres, has been published by Dravo Corp., Fifth and Liberty Aves., Pittsburgh 22. Information is given on the various requirements for conditioning these cabs, and data are given on the mechanical and functional features of the company's cooling equipment.

No. 7394: Dehumidification—As consultants to Pittsburgh Lectrodryer Corp., P. O. Box 1766, Pittsburgh 30, Professors E. R. Queer and E. R. McLaughlin have prepared the second in a series of bulletins. Entitled The

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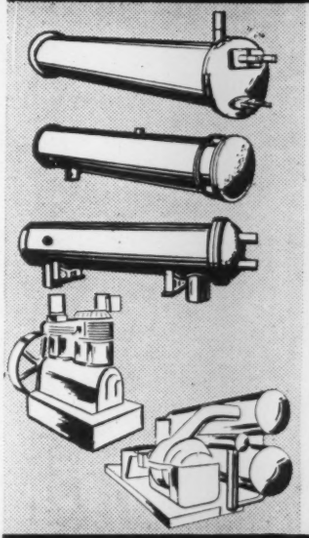

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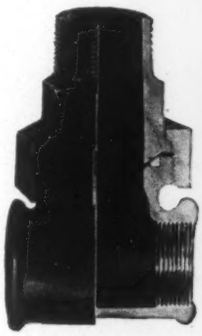

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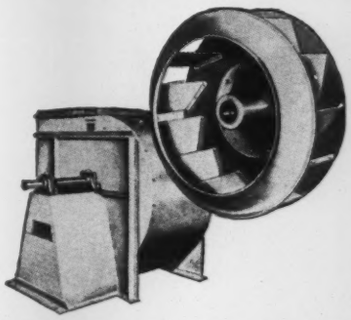

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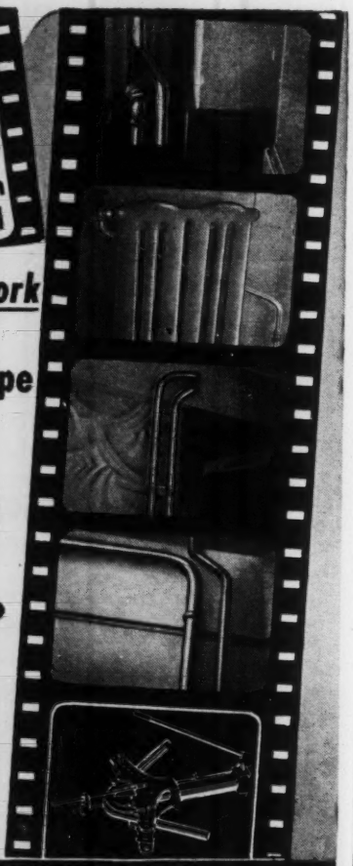

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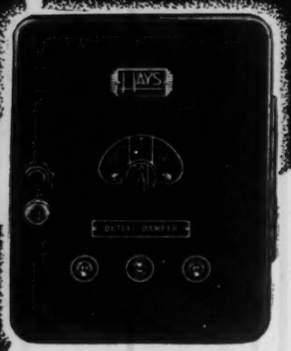

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Moisture in Our Atmosphere—Its Nature, Behavior and Measurement, Bulletin No. 218 deals with the fundamental physics of water vapor as related to solid adsorption dehumidification.

No. 7395: Design Procedure for Radiant Panel Heating—A procedure for design of radiant panel heating, said to be "so simple and straightforward that it can be used by the average plumbing and heating contractor without engineering training," is set forth in a new 28 page booklet issued by the research department of Revere Copper and Brass Inc., 230 Park Ave., New York 17. The procedure is intended for residences and other nonmechanically ventilated structures.

No. 7396: Diaphragm Control Valves and Bypasses—Minneapolis-Honeywell Regulator Co., Belfield Valve Division, Philadelphia 44, has issued two new booklets. Bulletin 254-1 describes the operation and construction of the Schaefer bypass for traps, valves, and other pressure units, as well as the union bonnet type for general marine service. Bulletin 350-1 gives dimensions and operating data on air operated diaphragm control valves, with charts on various types such as direct and reverse acting; bronze body reversible, single seat; bronze body, integral seats and renewable seats, three-way valves; and iron body, single seat, "on-off."

No. 7397: Electric Motors—The improved line of horizontal "Uniclosed" motors in horsepower ratings from ¼ to 250 is covered in an eight page bulletin (No. 1524) prepared by U. S. Electrical Motors, Inc., 200 E. Slauson Ave., Los Angeles 54. Some of the features described are armorclad asbestos-protected windings, the drip-proof housing, "Lubriflush" lubrication, normalized castings, cyclone ventilation, the "Centricast" rotor, and annealed laminations.

No. 7398: Flexible Chain Couplings—Roller chain stock couplings, silent chain stock couplings, heavy duty silent chain couplings, together with steel and plastic covers are described in a new 16 page catalog (No. C45-49) of Morse Chain Co., Div. of Borg-Warner Corp., 7601 Central, Detroit 8. Information is given on dimensions, horsepower ratings, stock and maximum bores, etc.

No. 7399: Gas Fired Heaters, Furnaces—A new set of literature describing "Janitrol" FEC forced warm air heaters and furnaces has been prepared by Surface Combustion Corp., Janitrol Div., Toledo 1. The literature is graphically illustrated with charts, cutaways, photographs and layouts, and includes a 10 page product folder describing equipment from the consumer standpoint and two broadsides presenting salient features for the benefit of dealers, etc.

No. 7400: Glass Blocks—Containing general and technical data, illustrations, construction details, and specifications, a new 40 page booklet on PC glass blocks has been released by Pittsburgh Corning Corp., 307 Fourth Ave., Pittsburgh 22. By dividing glass block patterns into decorative and functional groups and elaborating upon the advantages of each, the booklet is designed to simplify pattern selection.

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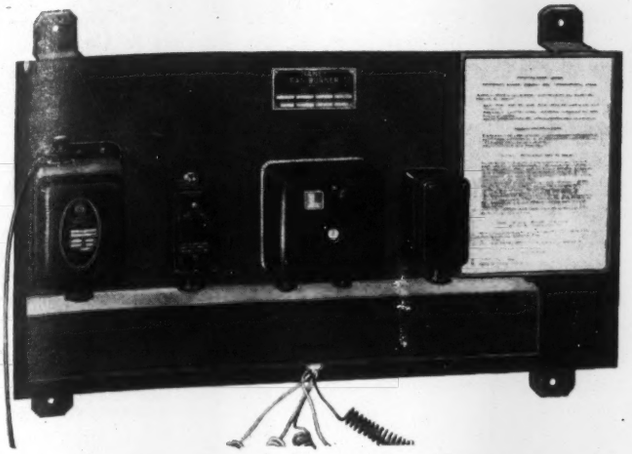

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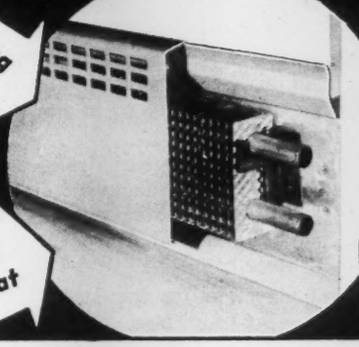

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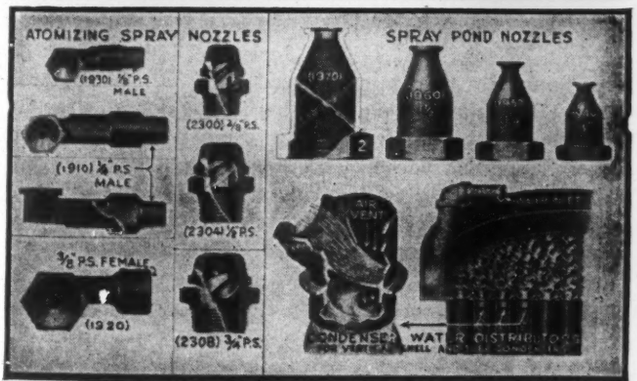

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THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost. It will pay you to consult us. WRITE or WIRE for further information.

Prompt Shipment From Stock

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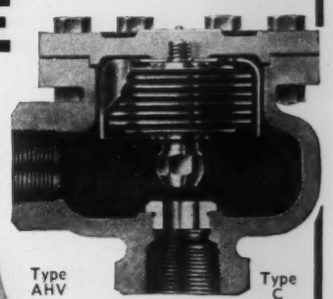
"Serving the Ice Industry Since 1916" — *There is no Substitute for* MARTOCELLO QUALITY

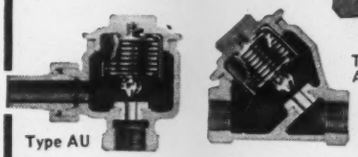
SAVE TIME - - Nicholson Steam Traps Require

NO CHANGE

of Valve or Seat

0 to 225 Lbs.





Nicholson steam traps save the time and trouble of adjusting valves for varying pressures. This feature substantially speeds maintenance and production. Made of hardened stainless steel, the valve is extra large, resulting in from 2 to 6 times average drainage capacity. Both valve and seat are renewable. The fast action of Nicholson traps prevents waterlogging. Installations have increased production of cooking kettles, for example, as much as 30%. Widely specified for preventing damage to thin gauges. Eliminate "cold blow" in unit heaters. 5 types for every application. Size ¼" to 2"; press. to 225 lbs. BULLETIN 1047.

W. H. NICHOLSON & CO. 198 OREGON STREET WILKES-BARRE, PA.

Valves ● Traps ● Steam Specialties

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Makes a hit with firemen

Compared to the *big* features of the Brownell Standard Electric-Welded Steel Boiler, the rear service door looks like a minor item. But firemen always comment on it. They say it's mighty handy for cleaning the fire tubes and rolling in new ones when eventually needed.

Besides understanding the technicalities of boiler design and construction, our engineers are practical. They know how to make boiler tending pleasanter and easier. That's why they incorporate so many conveniences in Brownell Boilers.

Get all the facts about our Standard Boilers by requesting Bulletin S-67 and new data sheet.

THE
BROWNELL
COMPANY
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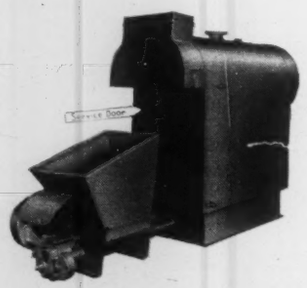
DAYTON 1, OHIO



Brownell Stoker-Boiler Combination. Stoker installed in rear of boiler.

G&O COILS *for* ***HEATING and COOLING***

G&O RADIATION

A full line of sizes now available to meet all industrial requirements. Send for catalog.

THE G&O MANUFACTURING COMPANY
New Haven 8, Connecticut
Pioneer Manufacturers of Square Finned Tubing in the United States

No. 7401: Hot Water Heating by Forced Circulation—The flow control system of H. A. Thrush & Co., Peru, Ind., is covered in a new condensed catalog (No. CC-549). Specialties described and illustrated include hot water circulators, flow control valves and fittings, relief and filling valves, pressure tanks, water heaters, and other components. Capacity tables and performance charts are included.

No. 7402: Hot Water Heating Specialties—Bulletin J-355 of The Trane Co., La Crosse, Wis., illustrates and briefly describes circulators, flow valves and fittings, relief and regulating valves, compression tanks, air valves, and other accessories. The design of a one pipe system is briefly covered. Bulletin DS-355 gives more detailed information, particularly on the new model C high head circulator and contains step-by-step procedures for the design of both one and two pipe systems. Friction loss data for pipe and fittings, circulator performance curves, piping diagrams, and suggestions for piping details near the boiler are included.

No. 7403: Industrial Fluid Cooling—Quiz No. 7 in a series, prepared by Marley Co., Inc., Fairfax and Marley Rds., Kansas City 15, Kans., contains 10 questions and answers. Factors covered include limitations of evaporative coolers, dry cooling, advantages and disadvantages of using well water, river water, and spray ponds, atmospheric heat exchanger sections, and combination open and closed cooling in a cooling tower.

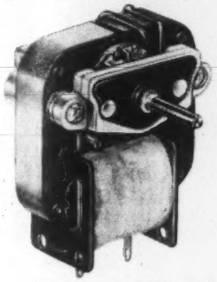
No. 7404: Industrial Gas Equipment—Condensed Catalog 292 of Bryant Industrial Div., Affiliated Gas Equipment, Inc., 1020 London Rd., Cleveland 10, describes and illustrates 33 items of gas combustion equipment. Capacities and dimension tables are included for combustion assemblies, gas-air and air-gas mixers, blowers and boosters, burner types, pilot and ignition devices, controls, valves, etc.

No. 7405: Insulation for Ducts, Pipes, Hot Water Tanks—Grant Wilson, Inc., 141 W. Jackson Blvd., Chicago 4, has prepared a new sample booklet on its asbestos protected "Duxsulation," showing both ½ and 1 in. sizes for insulating all types of ductwork. Two new promotional leaflets have also been released recently. One illustrates the firm's line of pipe covering for hot and cold water and medium and low pressure steam lines. The other describes asbestos jackets for hot water tanks.

No. 7406: Names of Valve Parts—Cooper Alloy Foundry Co., Hillside 5, N.J., has issued a new bulletin giving names of valve parts. Diagrammatic sketches of gate, globe, check, and lever operated valves are presented, along with a uniform material and parts identification code. This is said to be the first publication of its type to follow the newly proposed standard designations of the Manufacturers' Standardization Committee.

No. 7407: Pipe Fittings—Catalog No. 50, issued by Union Malleable Mfg. Co., Ashland, Ohio, covers malleable iron pipe fittings, cast solder joint fittings, and steel nipples. Replacing all previous catalogs, it contains a complete description of fittings with list prices and weights.

RAYTHEON *New Principle*
TYPE 230-FRAME MOTORS



Type 230 Deluxe Model with die-cast bearing brackets.

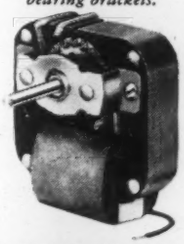
The efficiency of Raytheon Type 230 Motors is almost double the value ordinarily obtained in shaded 2-pole motors of this size. It is typical of all Type 230 motors that the speed torque curve is unusually flat between "No Load" and "Pull Out". The Starting Torque and Pull Up Torque are likewise *unusually* high!

Better speed stability under variable operating voltages is possible with this flatter speed torque curve. The result is MORE HORSEPOWER PER POUND!

DELUXE MODEL: *for use on phonographs, wire and tape recorders, sound projectors . . .*
ECONOMY MODEL: *for use on desk fans, electric heater fans, toys, vending machines, projector cooling blowers, slide projectors . . .*

For complete data, specifications and illustrations on the entire line of 230-Frame Motors send for NEW HELPFUL BULLETIN 1000.

Type 230 Economy Model with brass-strap bearing brackets.



RUSSELL ELECTRIC COMPANY
Subsidiary of Raytheon Mfg. Co.
4501 So. Western Blvd. • Chicago 9, Illinois

Pump Talk

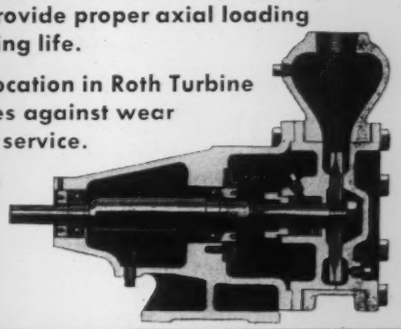
Roth Pumps last longer because of positive impeller location.

The life of a turbine type pump depends on the wear that takes place between impeller and side plate. Positive location of the impeller is a most important factor in preventing wear.

Only the Roth Turbine Type Pump eliminates bearing end play and provides positive impeller location. The impeller shaft assembly is located by locking the opposite sides of both ball bearings. Bearing end play is taken up by a pre-loading spring. This spring is recommended by bearing manufacturer to provide proper axial loading and increase bearing life.

Positive impeller location in Roth Turbine Type Pumps insures against wear and adds years of service.

For full data, write for catalog section 101.



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ALBANY HOUSES, TOO.

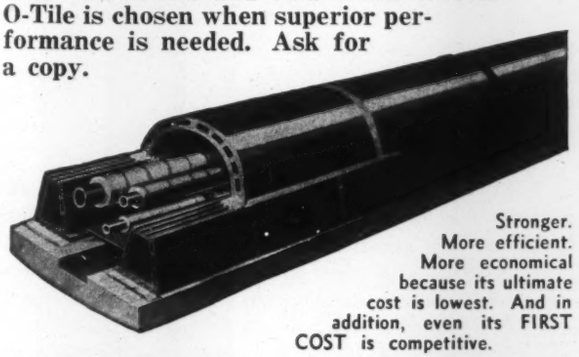
This is the eleventh of New York City's huge housing projects to select

THERM-O-TILE

Reg. U.S. Pat. Off.

Underground Steam Conduit . . .

The preceding ten were named in advertisements in this magazine during the past year. See, particularly, the ad in the January issue which tells about the largest of its kind. Bulletin 381 shows and tells WHY Therm-O-Tile is chosen when superior performance is needed. Ask for a copy.



Stronger. More efficient. More economical because its ultimate cost is lowest. And in addition, even its FIRST COST is competitive.

Sold and installed by Johns-Manville Construction Units in all Principal Cities.

H. W. PORTER & CO., Inc.
822-H Frelinghuysen Ave. Newark 5, N. J.

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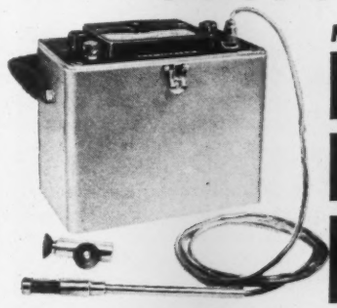

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AIR VELOCITY
FROM 10FPM to 6,000FPM

AIR TEMPERATURE
FROM 30F to 155F

STATIC PRESSURE
FROM 0 TO 4 NEG. AND FROM 0 TO 10 POS. IN. WG

This precision instrument gives vital data on the performance and efficiency of heating, ventilating and air conditioning systems. Direct, instantaneous readings.

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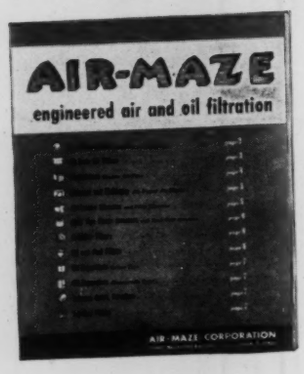
JUST OUT! Your guide to better air and oil filtration! FREE!



This new Air-Maze catalogue gives you information you should have about the latest developments in air and liquid filtration. Whether you build or use engines, compressors, air conditioning and ventilating equipment, or any device using air or liquids, you'll want to have this handy guide at your finger tips. Send for your free copy today!

INCLUDES PICTURES AND INFORMATION OF THE FOLLOWING AIR-MAZE PRODUCTS:

- Air filter panels and water eliminators
- Oil bath air filters
- Electromaze electric air filter
- Unimaze and Multimaze oil wetted air filters
- Air intake silencers and filter silencers
- Back fire flame arresters and tank vent arresters
- Breather filters
- Oil and fuel filters
- Oil separators, screen type
- Oil separators, electrostatic type
- Exhaust spark arresters
- Pipeline filters

AIR-MAZE CORPORATION, CLEVELAND 5, OHIO

No. 7408: Pipe Insulation—Kaylo Div., Owens-Illinois Glass Co., Box 1035, Toledo 1, has released a new folder on its pipe insulation. Information is given on specifying and using this calcium silicate insulating material which is said to be effective throughout the temperature range from 200 to 1200 F. Data are given on standard sizes and thicknesses, recommended thicknesses for various pipe sizes and temperatures, heat losses, efficiencies, and surface temperatures. The folder also explains how dimension standards of this insulation make it possible to build up multiple layers.

No. 7409: Pocket Sized Voltmeter and Ammeter—The new pocket type "Amprobe" is designed to measure a-c current without interrupting service and to measure a-c voltage. A plastic finger trigger opens transformer probes and clamps around the conductor to measure the current. To measure voltage, a pair of test leads is inserted into front mounted pin-jacks and connected to the line. Designed for electricians, motor repair shops, and maintenance men, the device is available in two models, each with seven ranges. Information is given in Catalog 109 of Pyramid Instrument Co., 49 Howard St., New York 13.

No. 7410: Pressure Gages—The new series 500 absolute pressure gages of Bristol Co., Waterbury 91, Conn., are described in Bulletin G620. The instrument is said to make possible the accurate recording and automatic control of pressure within a scale range as low as zero to 20 mm of mercury, absolute.

No. 7411: Psychrometric Chart—A new chart available from Baker Refrigeration Corp., South Windham, Me., is said to have a number of advantages. Enthalpy of air and moisture mixtures can be read directly without applying a correction factor. All constant enthalpy lines are parallel to each other and at right angles to the enthalpy scales. Lines drawn parallel to those in the sensible heat factor diagram "truly represent the ratio of change of enthalpy of the dry air to the change of total enthalpy of the mixture for any process within the range of the chart." Prepared by A. J. Mallinckrodt, chief application engineer, charts are available in tablets and are punched for loose leaf binding.

No. 7412: Refrigeration Compressors and Condensing Units—The complete line of Mills Industries, Inc., 4100 W. Fullerton Ave., Chicago 39, is described and illustrated in a new 60 page catalog (No. 204-1). Models include air cooled (¼ to 3 hp), water cooled (⅓ to 10 hp), and combination air and water cooled (½ to 3 hp). Specifications, dimensions, and other pertinent data are included.

No. 7413: Refrigeration Controls—A new 12 page condensed catalog describing its complete line of automatic controls for refrigeration and air conditioning is available from White-Rodgers Electric Co., 1209 Cass Ave., St. Louis 6. Controls covered include room thermostats, space thermostats, relays, pressure and hydraulic action temperature controls. Units for special applications such as explosionproof thermostats and automatic defrost controls are also covered.

No. 7414: Refrigeration Evaporators and Condensers—Two new refrigeration equipment catalogs have been

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To Sneak Profits when You Seal with

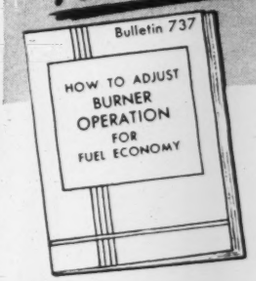
Leaks on lines carrying oil (hot or cold), gasoline, kerosene and high pressure steam are a costly waste. Key Graphite Paste provides a perfect seal for these lines. It expands under heat but will not freeze the connection. Joints completely sealed with Key Graphite Paste can be easily disconnected without damage to threads or gaskets. Eliminate expensive leakage with Key Graphite Paste. Listed by Underwriters Laboratories.

Try Key Graphite Paste in your own Plant at no cost. Send for liberal free sample.

KEY COMPANY
2617 McCastand Ave.
East St. Louis, Ill.

KEY Company

Fuel-Saving SERVICE Simplified



Fuel economy and heating comfort depend on proper fire size more than on any other single factor. Correct adjustment of the fuel-burning unit for proper on-and-off cycling and fuel input can be made quickly and dependably by an amazingly simple test which requires only the recorder shown below and takes less than 20 minutes of a service man's time.

FREE FACTS

The simple procedure of the heat test for adjusting burner operation for minimum fuel consumption and maximum heating comfort is clearly and completely described in the bulletin above. The bulletin also explains how this heat test dramatically demonstrates the need for replacement of an obsolete installation thus opening the way for profitable replacement business. Write for your free copy today.

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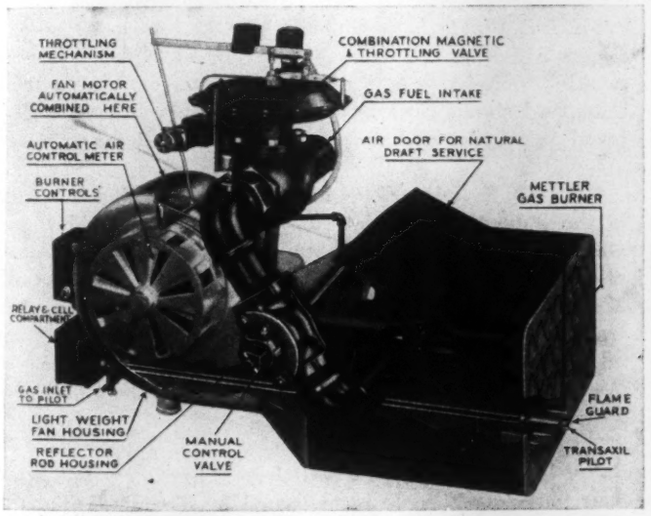
The Mettler "FAN-AIR" Gas Burner

LATEST MODEL FEATURES NEW AUTOMATIC SAFETY PILOT and TRIPLE CONTROLS



FOR YOUR PROTECTION AND SAFETY

Picture reveals some of the essential and desirable POINTS of FAN-AIR MECHANICAL DRAFT GAS BURNERS. Not just a burner but a COMPLETE and FULLY AUTOMATIC GAS BURNER SYSTEM, factory tested and ready for application when received. Furnished complete as pictured with simple, dependable automatic on and off or modulating controls. Burner and Controls WITH SPARK IGNITION and FLAME SAFEGUARDS are scientifically coordinated to provide INSTANT FUEL SHUT-OFF on FLAME FAILURE—MEETING APPROVAL REQUIREMENTS. Why be satisfied with less—when all these tangible advantages are so readily available.

Worthy of sponsorship for Scotch Marine Boilers
SIZES 5 to 400 H.P. *PROMPT SHIPMENTS*

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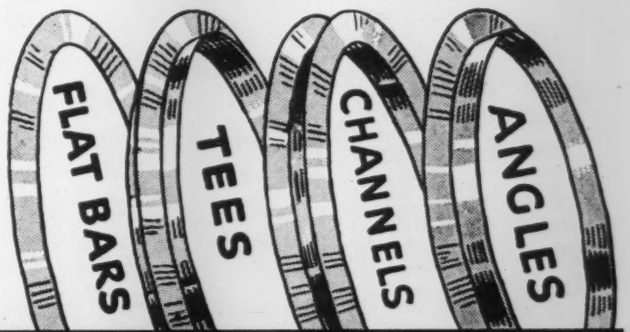

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SHEET METAL PRODUCTS FABRICATED TO SPECIFICATION

Shearing 12 ft. ¼ in.—Punching 210 Ton Cap.—Forming 15 ft. ⅜ in. Greater thickness in shorter lengths. Assembling—Welding (Arc. Acet. Spot) Riveting Single Units or in Quantity.

Write for illustrated circular today.

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DRILLS HOLES CLEAN FAST

WITH THE ORIGINAL

ROTARY CONCRETE DRILL BITS

DRILL BILLY says:

"MAKE BETTER HOLES FOR LESS MONEY"

Drilling through masonry with a Rotary Concrete Drill Bit is a revelation in speed, precision, saving. Used as directed, Rotary Bits will drill a profuse number of holes before dulling the sharp cutting edges. They can be re-sharpened many times, and will continue their high-speed efficiency with each sharpening. They'll save money for your concern. For use in ordinary electric or rotary drills. Standard sizes from ¼" to 2" diameter. Larger sizes on request. Free factory re-sharpening until further notice. Write for free illustrated folder giving complete details and prices.

ROTARY CONCRETE DRILL COMPANY

650 SOUTH ARROYO PARKWAY · PASADENA 1, CALIFORNIA

• The very smallness of the Skidmore Vertical Type "CV" Condensate Pump and Receiver, makes it ideal where space is limited. Yet, the Vertical Type "CV" Pump affords big performance with a wide range of selectivity. Adapted for condensate returns from all types steam heating and process equipment —centrifugal type—maintained efficiency.

Capacities ranging from 500 to 10,000 sq. ft. E.D.R. Discharge pressures from 10 to 20 pounds. Write today for Bulletin No. 21 and engineering data, Dept. H.P.

SKIDMORE PUMPS

ST. JOSEPH, MICHIGAN

released by Bell & Gossett Co., Morton Grove, Ill. Catalog BJ-848 provides data on "Hydro-Flo" direct expansion evaporators and includes a section on simplified selection procedure and diagrams of typical systems. Catalog CD-649 features finned tube condensers in both straight tube and U bend models. Methods of selection, capacities, dimensions, and other data are given.

No. 7415: Refrigeration Valves—A single page data sheet and price list of Henry Valve Co., Melrose Park, Ill., covers wing cap valves for ammonia and "Freon." Equipped with patented nonrotating valve stem discs, valves are back-seated and are available in nonferrous alloy with solder connections, in semi-steel with pipe thread connections, and in semi-steel with companion flanges.

No. 7416: Regulating Valves—Bulletin 47-1 on pilot single seat, balanced regulating valves, type FB, provides detailed information on four general classes. Data are given on slip-stem and rotary shaft types for steam, air, gas, and liquids. According to Minneapolis-Honeywell Regulator Co., Belfield Valve Division, Philadelphia 44, units have many advantages in the process and other industries.

No. 7417: Servicing Single Phase Motors—The second of a series of articles on motor service by A. W. Bohn, is contained in the July issue of the house organ published by Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 14. This article deals with rotors for repulsion-start induction motors. Also featured are illustrations showing some of the uses of the firm's motors and transformers in the oil industry.

No. 7418: Small Thermostats—A new illustrated bulletin (F-2001) on type M bimetal disc thermostats for communications equipment, appliances, and electrical apparatus is available from Stevens Mfg. Co., Inc., Mansfield, Ohio. Stressing quick make and break operation, the booklet includes a typical response curve, construction data, and shows a variety of terminal arrangements offered on regular or hermetically sealed models.

No. 7419: Stainless Steel in the Laundry Industry—This is the subject of the latest in a series of booklets on stainless steel in various industries, published by Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22. Starting with the history of the industry, the bulletin traces its development and describes how stainless has added to its efficiency and growth. Considerable space is devoted to properties, principal types, available forms and fabrication of the metal.

No. 7420: Starters and Switches—Three new bulletins, four pages each, have been issued by Trumbull Electric Mfg. Co., Plainville, Conn. Bulletin TEC-317A covers the new TT manual starter which provides overload protection for small motors up to 1 hp. Bulletin TEC-302A deals with type A, style A, heavy duty industrial safety switches, and Bulletin TEC-1 gives information on the type D, front operated, enclosed switch.

No. 7421: Steam Traps—A number of suggestions for determining economical steam pipe sizes are contained in the leadoff article of the No. 4 issue of the house organ

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REMPE CO.
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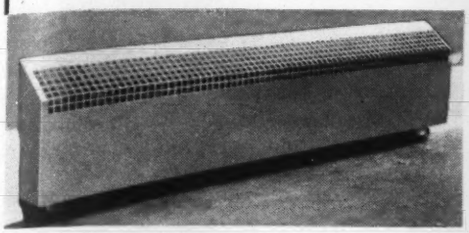

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- Night Clubs
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FOR INSTALLATION ABOVE OR IN BASEBOARD
FOR STEAM OR HOT WATER

Attractive, easy to install Fin Tube Convector for new installations or replacement of cast iron radiators.

Strong slanted perforated steel cover directs air upward and away from wall. Only 8″ high x 3″ deep—any length.

Rempe method of manufacture gives greater BTU capacity per lineal foot. EDR capacity 4.75 per lineal foot of casing length.

Write for prices and discounts.

REMPE CO.
342 No. Sacramento Blvd., Chicago

Pipe and Fin Coils for Refrigeration and Air Conditioning.

DISTINCTIVE FEATURES — The soft steel blades are made in pairs, pressed thru slots in the heavy steel back plate, then welded to the plate. The blade tips are pressed thru slots in the inlet disc then bent back against the spring of the steel blades. This ***patented construction*** results in an exceptionally rigid wheel and ***prevents loose blades,*** as no rivets are used in fastening the blades. The heavy cast iron machined hub is riveted to the back plate and will not crack or become loose on the shaft.

JAN-AIR, INC. Manufacturers
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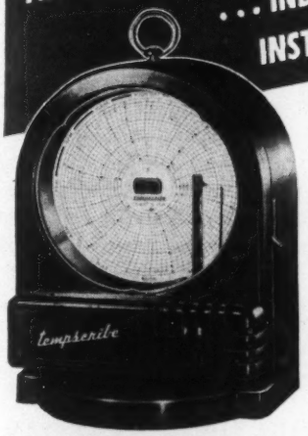
The *tempscribe* RECORDER ... INDISPENSABLE for SALES, INSTALLATION and SERVICE



- SHOWS NEED FOR REPAIRS OR MODERNIZATION OF HEATING INSTALLATIONS!
- DEMONSTRATES THE HEATING COMFORTS THAT WILL RESULT FROM THE RECOMMENDED IMPROVEMENTS!
- SETTLES COMPLAINTS DIPLOMATICALLY AND KEEPS YOUR CUSTOMERS SATISFIED!

The TEMPSCRIBE Temperature Recorder makes round-the-clock records that show highest and lowest temperature for 24 hours, temperature extremes, and frequency of temperature fluctuations. Compact, self-contained; no electrical connection, requires no watching.

The TEMPSCRIBE can save your time and money on service calls—*and build your reputation for reliable, expert service.*

Ask your jobber about TEMPSCRIBE Recorders, or write for Bulletin 704.

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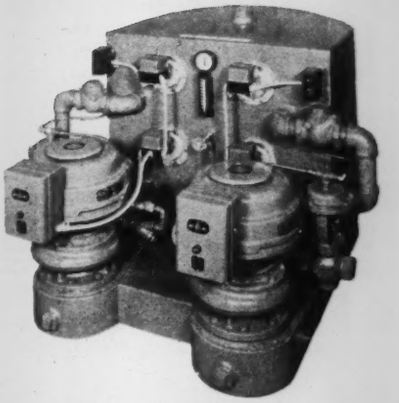
MOTOR OPERATION RECORDER
. . . records on-and-off periods showing cycling frequency, length of running time, and percentage of heating capacity utilized.

Vacuum Heating Pumps

Single and Duplex Units



Capacities from 2,500 through 300,000 E.D.R.

Whittington Vacuum Heating Pumps maintain 28″ Hg vacuum at shut-off conditions, using 70° water; thus can handle water nearer the evaporation point. Operate on economical water-jet principle, offering greater capacity at normal vacuum range with no loss of capacity during life of pump. Only one moving part. No close clearances to cause wear. No stuffing box under vacuum. Whittington pumps are packaged units, with pump, motor and accumulator integrally mounted. Nationwide sales and engineering service. Write for Bulletin HP-48. Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Indiana.

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